Pretrial Risk Assessment Tool Validation

PRETRIAL PILOT PROGRAM

JUNE 2021

JUDICIAL COUNCIL OF CALIFORNIA
OPERATIONS AND PROGRAMS DIVISION
CRIMINAL JUSTICE SERVICES

CONTENTS

EXECUTIVE SUMMARY

This report fulfills the legislative mandates of the Budget Act of 2019 (Assem. Bill 74; Stats. 2019, ch. 23), and Senate Bill 36 (Stats. 2019, ch. 589). SB 36 requires each pretrial services agency that uses a pretrial risk assessment tool, including the Pretrial Pilot Projects, to validate the risk assessment tool used by the program by July 1, 2021, and to make specified information regarding the tool, including validation studies, publicly available. The Judicial Council is required to maintain a list of pretrial services agencies that have satisfied those validation requirements and complied with those transparency requirements. AB 74 also provided funding to the Judicial Council to assist the pretrial pilot courts in validating their risk assessment tools.

In response to the requirements of AB 74 and SB 36, the Judicial Council of California conducted the following validation studies for four pretrial risk assessment tools. The period for this validation extends from October 1, 2019 – December 31, 2020 and includes a diverse sample of counties in California. Among the counties, population size ranges from less than 10 thousand to over 10 million, geographic regions range North to South as well as inland and coastal. Demographically, the counties represent both majority Hispanic and Non-Hispanic White populations.

The Judicial Council conducted pretrial risk assessment validation studies for:

- Ohio Risk Assessment System Pretrial Assessment Tool (ORAS-PAT), developed by the University of Cincinnati, Center for Criminal Justice Research - used by the Pretrial Pilot Projects in Modoc, Napa, Nevada/Sierra, Ventura, and Yuba counties.
- Public Safety Assessment (PSA), developed by Arnold Ventures - used by the Pretrial Pilot Projects in Calaveras, Los Angeles, Sacramento, Sonoma, and Tuolumne counties.
- Virginia Pretrial Risk Assessment Instrument (VPRAI), developed by the Virginia Department of Criminal Justice Services - used by the Pretrial Pilot Projects in San Joaquin and Santa Barbara counties.
- Variations of the VPRAI (VPRAI-R and VPRAI-O) - used by the Pretrial Pilot Projects in Alameda, Kings, San Mateo, and Santa Barbara counties.

This report includes the following validation studies:

- Overall validations for the PSA and VPRAI tools, and a study of predictive validity of the tools by race/ethnicity and gender.
- Overall validations for the ORAS and VPRAI-R tools.

If larger sample sizes become available, the Judicial Council will conduct a validation study for the VPRAI-O risk assessment tool, and test the predictive validity of the ORAS, VPRAI-R and VPRAI-O tools by race/ethnicity and gender.

The risk scores presented in this report are calculated using a scoring scheme designed by tool developers. The tools take into account aspects of an individual's criminal history, current criminal offense, history of failures to appear in court, age, and other factors depending on the tool (see

appendix X for the factors and weights specific to each tool). Gender and race are not used in any of the tools to calculate risk scores.

In conducting the validations, the Judicial Council used the Area Under the Curve (AUC) and logistic regression to examine the tools' accuracy and reliability. The AUC value is a single number that represents the ability of the tool to differentiate between individuals who are lower or higher risk across the range of the tool. The AUC is calculated for each tool overall and, when the sample size is sufficient, separately for each gender and race/ethnicity group to examine whether the ability of the tool to differentiate individuals by risk differs by gender or race/ethnicity. Logistic regression is used to test whether risk scores statistically significantly predict the likelihood of each outcome of interest (failure to appear; new arrest; new filing; new conviction; new violent arrest; and a composite measure of FTA or new arrest), and whether any differences in outcomes by risk level across gender or race/ethnicity are statistically significant. Statistical significance is a technical term used in analyses to indicate that it is very unlikely that a result or difference occurred by chance. Statistical significance does not necessarily indicate the size of the result or difference.

In the validation studies conducted by the Judicial Council, using a common metric for interpreting AUC values in criminal justice risk assessments, all tools have a AUCs in the good to excellent ranges for nearly all measured outcomes, both overall and for all of the race/ethnicity and gender subgroups analyzed, and AUCs in the fair range in a limited number of categories.

Results of the regression analyses show that the association between risk score and all outcomes of interest was statistically significant. When analyzed by race, ethnicity and gender, some statistically significant differences were found in both the PSA and VPRAI in most outcomes. Further research is needed to analyze the elements that may be driving the observed differences and whether there are data-driven modifications to the tools' risk factors or weights that can further improve the predictive power of the tools.

This report solely analyzes risk scores and associated outcomes for individuals who were released pretrial. Individuals may have been released by the Sheriff, by a judge, or on bail. This report does not look at judicial decision-making or judges' use of the tools.

We would like to thank the courts and their justice partners in the pilot counties for their participation in these validation studies.

INTRODUCTION

LEGISLATIVE MANDATE

This report fulfills the legislative mandates of the Budget Act of 2019 (Assem. Bill 74; Stats. 2019, ch. 23), and Senate Bill 36 (Stats. 2019, ch. 589). In AB 74, the Legislature directed the Judicial Council to administer two-year pretrial projects in the trial courts. The goals of the Pretrial Pilot Program, as set by the Legislature, are to:

- Increase the safe and efficient prearraignment and pretrial release of individuals booked into jail;
- Implement monitoring practices with the least restrictive interventions necessary to enhance public safety and return to court;
- Expand the use and validation of pretrial risk assessment tools that make their factors, weights, and studies publicly available; and
- Assess any disparate impact or bias that may result from the implementation of these programs.

Sixteen Pretrial Pilot Projects (17 courts) were selected to participate in the program.[1]

SB 36 requires each pretrial services agency that uses a pretrial risk assessment tool, including the Pretrial Pilot Projects, to validate the risk assessment tool used by the program by July 1, 2021, and on a regular basis thereafter, and to make specified information regarding the tool, including validation studies, publicly available. The Judicial Council is required to maintain a list of pretrial services agencies that have satisfied those validation requirements and complied with those transparency requirements. The Judicial Council is also required to publish a report on the judicial branch's public website with data related to outcomes and potential biases in pretrial release.

AB 74 provided funding to the Judicial Council "for costs associated with implementing and evaluating these programs, including, but not limited to: [¶] ….(e) Assisting the pilot courts in validating their risk assessment tools." This report, in accordance with AB 74 and SB 36, provides information on the validation of the pretrial risk assessment tools used by the 17 Pretrial Pilot courts.

Pretrial risk assessment tools use actuarial algorithms to assess the likelihood that a person who has been arrested for an offense will fail to appear in court as required or will commit a new offense during the pretrial period. The pretrial risk assessment tools used by the 16 Pretrial Pilot Projects are:

- ORAS (Ohio Risk Assessment System; developed by the University of Cincinnati, Center for Criminal Justice Research)
- PSA (Public Safety Assessment; developed by the Laura and John Arnold Foundation)

[1] The pilot counties are Alameda, Calaveras, Kings, Los Angeles, Modoc, Napa, Nevada, Sacramento, San Joaquin, San Mateo, Santa Barbara, Sierra, Sonoma, Tulare, Tuolumne, Ventura, and Yuba Counties. Nevada and Sierra Counties participated as a consortium.

- VPRAI (the Virginia Pretrial Risk Assessment Instrument, developed by the Virginia Department of Criminal Justice Services)
- VPRAI-R and VPRAI-O (variations of the VPRAI)

SB 36 requires pretrial risk assessment tools to be validated. SB 36 defines "validate" as follows:

> "Validate" means using scientifically accepted methods to measure both of the following:
> (A) The accuracy and reliability of the risk assessment tool in assessing (i) the risk that an assessed person will fail to appear in court as required and (ii) the risk to public safety due to the commission of a new criminal offense if the person is released before the adjudication of the current criminal offense for which they have been charged.
> (B) Any disparate effect or bias in the risk assessment tool based on gender, race, or ethnicity.

(Sen. Bill 36, § 1320.35(b)(4).)

VALIDATION METHODS

The following methodology has been used to validate each of the pretrial risk assessment tools used by Pretrial Pilot Projects for which data were sufficient.

Descriptive statistics are presented, exploring basic features of the data such as demographics, and showing the overall distributions of arrest offenses and adverse outcomes. The distributions of risk scores are shown in groupings of risk level defined by each tool developer.

A receiver operating characteristic (ROC) curve model has been used to provide the area under the curve (AUC) statistic for each outcome of interest. The outcomes of interest are:

- Failure to appear (FTA)
- New arrest
- New filing
- New conviction
- New violent arrest
- FTA or new arrest (composite measure)

The AUC statistic is a single number that summarizes the overall discriminative ability of the tool.

The observed rate of adverse outcomes at each score is presented. The pattern of these rates is an indicator of the accuracy of the tool, showing whether risk scores predict monotonic increasing failure rates for each outcome of interest.

Logistic regression has been used to test whether risk scores are statistically significant predictors of the likelihood of each outcome of interest.

The AUC has been calculated separately for each gender and race/ethnicity group to examine whether the discriminative ability of the tool differs by gender or race/ethnicity. To measure any predictive bias in the tools, fitted curves of the rates of adverse outcomes at each score are shown separately by gender and race/ethnicity groups. Logistic regression has been used to test whether the likelihood of each outcome of interest by risk level differs statistically across gender or race/ethnicity groups.

DEFINITIONS

- **Pretrial period** is the time period starting at booking of an individual at the jail and ending at resolution of any and all cases associated with that booking.
- **Failure to appear** (FTA) is measured using court records documenting issuance of a bench warrant for FTA during the pretrial period.
- **New arrest**[2] is any new arrest during the pretrial period reported to the California Department of Justice (CA DOJ).
- **New filing** is any new arrest, during the pretrial period, that results in charges filed with the court and reported to the CA DOJ.[3]
- **New conviction** is any new arrest during the pretrial period that results in a conviction reported to the DOJ during the data collection period.[4]
- **New violent arrest** is any new arrest during the pretrial period for an offense on the Pretrial Pilot consensus PSA Violent Offense List, which includes felonies and misdemeanors of a violent nature. For the full list of offenses, see Appendix A.
- **FTA or new arrest** is a combined measure indicating an occurrence of an FTA, a new arrest, or both. This measure is shown for the ORAS, VPRAI, and VPRAI-R which were designed to predict overall "pretrial failure." This measure is not shown for the PSA because it was designed to predict outcomes separately.

VALIDATION SAMPLE SIZES

For purposes of this report, general validation results are shown when the sample size was greater than 200. For analyses of predictive bias by race/ethnicity and gender, subgroup results are shown when the overall sample was at least 1,000 and each subgroup size was greater than 200. Sample sizes smaller than these may not produce reliable results.

DATA DESCRIPTION AND LIMITATIONS

The data set for the pretrial risk assessment tool validations was created using data from the court and two agencies in each of the Pretrial Pilot Program counties, as well as statewide data from the California

[2] New criminal offenses are defined in four ways to capture different outcomes of interest. All new criminal offense indicators are measured using data from the California Department of Justice (CA DOJ).

[3] CA DOJ records on arrests are likely more complete than CA DOJ records on court filings and dispositions. Court reporting to the CA DOJ is incomplete.

[4] Because of the short time frame of the data collection period and delays in court reporting to the DOJ, new convictions may not be a complete measure of all arrests, during the pretrial period, that result in a conviction.

Department of Justice. Although the number of assessed bookings during this period totaled 134,253, the evaluation data set used in this validation tracks the records of 23,353 bookings with associated pretrial risk assessments and completed pretrial periods; assessed bookings without completed pretrial periods or for which the individual was not released pretrial are not included in the evaluation data set.

The risk scores presented in this report are calculated using a scoring scheme designed by tool developers. The tools take into account aspects of an individual's criminal history, current criminal offense, history of failures to appear in court, and other factors depending on the tool (see Appendix A for the factors and weights specific to each tool). Gender and race are not used in any of the tools to calculate risk scores.

This report solely analyzes risk scores and associated outcomes for individuals who were released pretrial. Individuals may have been released by the Sheriff, by a judge, or on bail. This report does not look at judicial decision-making or judges' use of the tools.

DATA SOURCES

- **Jail booking data**: County sheriffs' offices provided information on all individuals booked into local county jails, including booking dates, charges, and releases.
- **Probation data**: County probation departments performed pretrial assessment services and provided pretrial risk assessment information, including assessment dates, scores, and recommendations for those assessed.
- **Court case data**: Superior courts provided court case information, including pretrial disposition dates and the issuance of warrants for failures to appear for individuals people with felony or misdemeanor criminal filings.
- **California Department of Justice Data:** CA DOJ provided arrest and disposition data, including out-of-county filings, for booked defendants.

DATE RANGE

The time period for this validation extends from October 1, 2019 to December 31, 2020, for most counties.[5] October 1, 2019, marks the beginning of the Pretrial Pilot Program grant period.

[5] See Appendix B for date range for each county.

Table 1. Assessment Date Ranges, by Tool

Tool Name	Earliest Assessment Date	Latest Assessment Date
ORAS	2019-10-03	2020-12-22
PSA	2019-10-12	2020-12-31
VPRAI	2016-11-08	2020-12-31
VPRAIR	2020-04-28	2021-01-05

DATA LINKING AND FILTERING

After data were collected from each source, they were standardized and linked together to create a validation data set of bookings with associated pretrial risk assessment information, relevant court case information, and outcomes during the pretrial period. In most counties, local justice agencies keep separate data systems, and not all data were able to be matched across agencies. The only bookings included in the validation data set were those for which the individual was released pretrial and there was a final disposition associated with the booking because outcomes during the pretrial period were a primary interest of this analysis and also so that the full pretrial period could be observed. This report refers to each booking linked with an associated assessment and completed pretrial period as a "pretrial observation."

The tables below show the number of assessments for each tool and county at each stage of filtering, and the type of validation that will be presented based on the sample size. It is anticipated that validation of all tools and for all counties will be completed when sample sizes reach the thresholds described under Validation Sample Sizes, above.[6]

The number of assessments performed during the evaluation period ranged from a low of 691 assessments for the VPRAI-O (Kings County) to a high of 92,791 assessments for the PSA (Calaveras, Los Angeles, Sacramento, Sonoma, and Tuolumne Counties). The next column represents assessments linked to unique jail bookings, ranging from a low of 250 for the VPRAI-O to a high of 80,800 for the PSA. The next column shows the number of bookings with associated pretrial risk assessments that have a final disposition. Linking bookings with pretrial risk assessments and selecting only cases with a final disposition lowers the sample to a range of 41–34,270 observations. Because of the limited time period for the evaluation, this drop in observations is expected.[7] The next column shows the evaluation sample of bookings with associated pretrial risk assessments that have a final disposition, and in which the defendant was released pretrial. The evaluation samples range from 14 to 14,849 pretrial observations. A large portion of the time frame for the evaluation data set overlapped with the COVID-19 pandemic, which likely had large impacts on crime, policing and booking practices, and the ability of courts to process cases, likely lowering the number of cases with a final disposition during this time frame.

[6] Santa Barbara switched from the VPRAI to the VPRAI-R during the pilot period. Data will be used in the pilotwide tool validation of both tools, but Santa Barbara County–level validation will be performed only for the VPRAI-R because the VPRAI is no longer in use in Santa Barbara.

[7] The VPRAI tool experiences a smaller relative drop in observations because of the longer time frame of the VPRAI assessments (see Table 1 for date ranges for each tool).

Because the sample size for the VPRAI-O was smaller than the designated minimum sample size of 200 for general validation, it was not possible to validate the VPRAI-O risk assessment tool in the current validation study.

Table 2: Counts of All Assessments at Each Stage of Filtration for Evaluation Sample, by Tool

Tool Name	Assessments	Assessed Bookings	Pretrial Complete	Released Pretrial	Validation Type
PSA	92,791	80,800	34,270	14,849	General + Bias
VPRAI	27,782	18,843	16,934	6,900	General + Bias
ORAS	5,067	4,122	2,047	844	General Only
VPRAIR	7,922	7,315	4,197	760	General Only
VPRAIO	691	250	41	14	Sample Too Small

Table 3: Counts of All Assessments at Each Stage of Filtration for Evaluation Sample, by County

County	Tool Name	Assessments	Assessed Bookings	Pretrial Complete	Released	Validation Type
Alameda	VPRAIR	4,766	4,933	3,118	368	General Only
Calaveras	PSA	301	232	150	63	Sample Too Small
Kings	VPRAIO	691	250	51	13	Sample Too Small
Los Angeles	PSA	73,437	72,594	29,926	13,247	General + Bias
Modoc	ORAS	226	173	16	4	Sample Too Small
Napa	ORAS	588	441	200	45	Sample Too Small
Nevada/Sierra	ORAS	222	165	78	12	Sample Too Small
Sacramento	PSA	16,808	6,018	3,561	1,303	General + Bias
San Joaquin	VPRAI	26,950	18,304	16,678	6,715	General + Bias
San Mateo	VPRAIR	1,583	1,448	613	165	Sample Too Small
Santa Barbara	VPRAI	832	963	744	265	No longer in use
Santa Barbara	VPRAIR	1,573	1,232	780	247	General Only
Sonoma	PSA	1,902	1,465	683	218	General Only
Tuolumne	PSA	343	491	77	17	Sample Too Small
Ventura	ORAS	3,747	3,081	1,624	725	General Only
Yuba	ORAS	284	123	123	49	Sample Too Small

DESCRIPTIVE STATISTICS

PRETRIAL TOOLS

This report addresses the validation of four pretrial risk assessment tools: Ohio Risk Assessment System–Pretrial Assessment Tool (ORAS-PAT), Public Safety Assessment (PSA), Virginia Pretrial Risk Assessment Instrument (VPRAI), and Virginia Pretrial Risk Assessment Instrument–Revised (VPRAI-R). The Pretrial Pilot Program counties using each of these tools and included in the evaluation data set are listed in Table 4.

Table 4. Counties Contributing Assessment Data for Each Assessment Tool

Tool Name	County	Pretrial Observations
ORAS	Modoc, Napa, Nevada, Ventura, Yuba	844
PSA	Calaveras, Los Angeles, Sacramento, Sonoma, Tuolumne	14,849
VPRAI	San Joaquin, Santa Barbara	6,900
VPRAIR	Alameda, San Mateo, Santa Barbara	760
All	**All**	**23,353**

DEMOGRAPHICS

The pretrial programs evaluated in this validation come from a diverse sample of counties in California. Among the counties, population sizes range from less than 10,000 to over 10 million, and geographic regions range north to south as well as inland and coastal. Demographically, the counties represent both majority Hispanic and non-Hispanic white populations.

Additionally, there are broad differences in the racial and ethnic makeup of the assessed populations in each county. For each pretrial risk assessment tool used, Table 5 provides the number of assessments in the evaluation data set, the racial/ethnic and gender makeup, and the median age. The proportions of each race and ethnicity vary widely across tools (6–27% Black, 40–56% Hispanic, and 19–36% white), gender[8] proportions vary moderately (14–23% female), and median age varies slightly (30–34 years). This pattern of variation across counties in criminal justice–involved populations is typical.[9]

Table 5. Demographic Profile of Evaluation Data Set, by Tool

		Race/Ethnicity (%)				Gender (%)		
Tool Name	Total	Black	White	Hispanic	Other	Male	Female	Median Age
ORAS	844	6	36	56	3	77	23	32
PSA	14,849	21	19	55	4	81	19	30
VPRAI	6,900	20	28	42	9	77	23	32
VPRAIR	760	27	24	40	9	86	14	34
TOTAL	**23,353**	**21**	**22**	**51**	**6**	**80**	**20**	**31**

ARREST OFFENSES

The arrest offenses leading to the bookings in the evaluation data set varied across counties. Felony arrests represented the majority of bookings (57–81%); misdemeanor arrests were a smaller share (19–

[8] Nonbinary, other, and unknown genders represented less than 0.1% of the bookings in the evaluation data set.

[9] See *www.ppic.org/publication/californias-county-jails/*; *www.ppic.org/interactive/interactive-arrests-in-california/*.

43%). Violent offenses[10] represented 20–37% of bookings in the data set; property offenses were 21–23% and drug offenses 14–29% of bookings in the data set. Driving under the influence (DUI) offenses ranged from 5% to 14% of bookings, and domestic violence (DV) offenses made up 15–35% of bookings in the evaluation data set.

Table 6. Distribution of Arrest Offense Type, by Tool (numbers shown in percentages)

Tool Name	Felony	Misdemeanor	Violent	Property	Drug	DUI	DV
ORAS	81	19	32	21	20	5	35
PSA	57	43	20	20	29	13	15
VPRAI	69	31	26	21	14	14	22
VPRAIR	74	26	37	23	21	6	30

ADVERSE OUTCOMES

Several different adverse outcomes are measured during the pretrial period from pretrial release to disposition. Failure to Appear (FTA), measured as bench warrants issued for FTA during the pretrial period, ranged from 9.7–36.5% of pretrial observations. New arrests during the pretrial period ranged from 31.6–38.2% of pretrial observations. New arrests during the pretrial period resulting in filed charges were recorded for 12.4–18.4% of pretrial observations, and new arrests during the pretrial period resulting in convictions were recorded for 8.8–11.7% of pretrial observations.[11] New violent arrests[12] (including felony and misdemeanor arrests for offenses of a violent nature) were recorded during the pretrial period for 8.8–11.2% of pretrial observations.

Table 7. Rates of Pretrial Misconduct, by Tool

Tool Name	FTA	New Arrest	New Filing	New Conviction	New Violent Arrest
ORAS	18.7	33.3	12.4	10.0	9.0
PSA	9.7	38.0	16.1	11.7	8.8
VPRAI	36.5	31.6	17.8	11.1	9.9
VPRAIR	19.5	38.2	18.4	8.8	11.2

[10] Violent offenses, as defined by the pilot consensus PSA Violent Offense List (see Appendix A). These offenses include both felonies and misdemeanors that are violent in nature.

[11] New arrest, new filing, and new conviction data are measured using CA DOJ data. New arrests and new violent arrests are reported to the CA DOJ from arresting agencies, whereas new filings and new convictions are reported to the CA DOJ from courts. The DOJ may have incomplete records of filings and convictions from the courts because of difficulties or delays in reporting, and not all new arrests during the pretrial period may have been resolved during the data collection period.

[12] New violent arrests are defined by the PSA Violent Offense List (see Appendix A).

CONDITIONS OF MONITORING/SUPERVISION

Data on supervision conditions were collected from county probation departments. However, data quality was low and was therefore not used in the analyses. Supervision conditions may have affected outcomes and may have been applied differentially according to risk score, which could confound results. Further research is needed to determine the impact of supervision conditions and to separate the efficacy of the tools from the efficacy of supervision conditions.

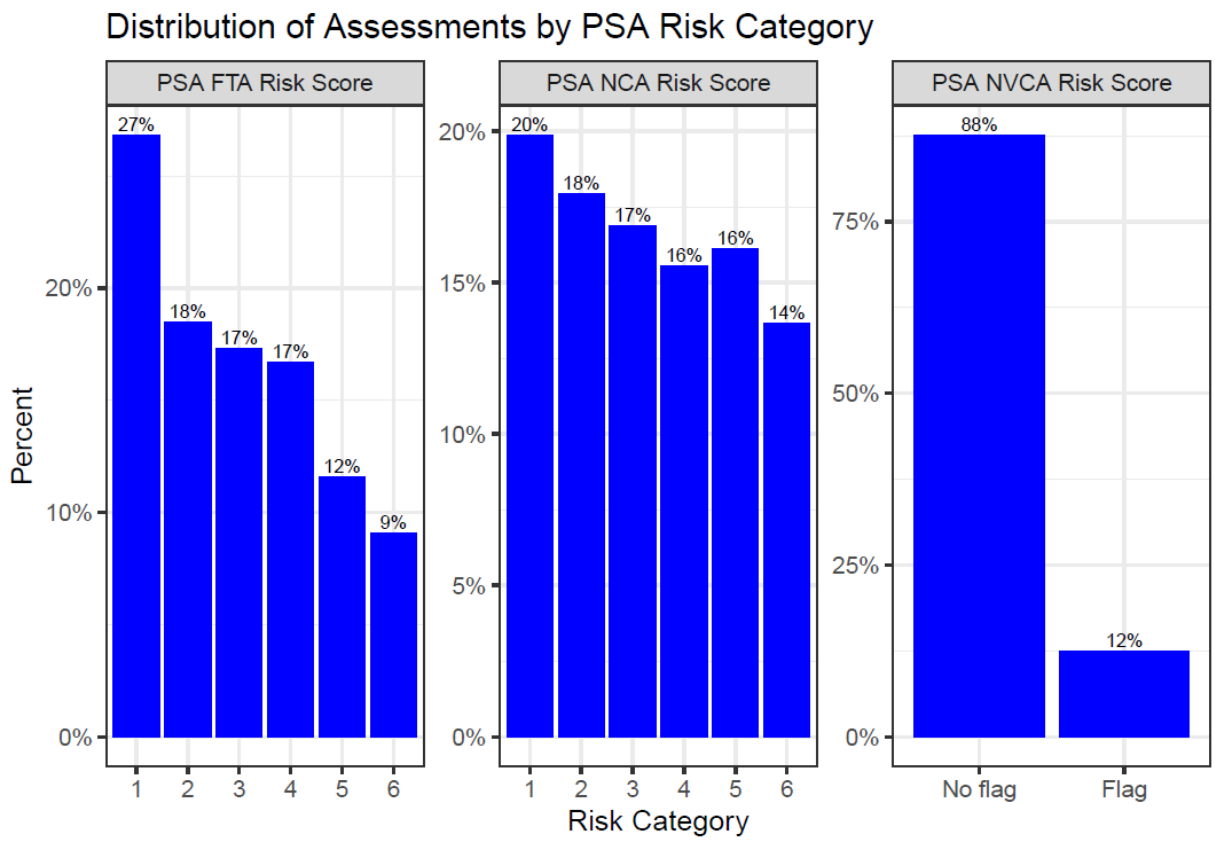
TOOL VALIDATION

PSA VALIDATION

GENERAL VALIDATION

The following charts show the distribution of risk categories for individuals in the evaluation data set assessed with the PSA tool—used by the Pretrial Pilot Projects in Calaveras, Los Angeles, Sacramento, Sonoma, and Tuolumne Counties—for each PSA subscale. The PSA subscale was designed to predict the risk of failure to appear in court. The PSA New Criminal Activity (NCA) scale was designed to predict the risk of a new arrest, and the PSA New Violent Criminal Activity (NVCA) flag was designed to predict new arrest for a violent crime. As determined by the tool developers, the FTA and NCA subscales are each divided into 6 risk levels, with 1 representing the lowest risk and 6 the highest, and the NVCA subscale is divided into a binary flag, such that a flag represents higher risk of new violent crime and no flag represents lower risk of new violent crime.[13] Lower scores were more common for both the FTA and NCA subscales, and only a small fraction of assessed individuals received an NVCA flag. The distribution of all assessed individuals may differ from the distribution in the evaluation data set because the evaluation data set includes only released individuals with concluded pretrial periods.

[13] The NVCA subscale is scaled to a 1–6 scale, scores 1–3 are categorized as no flag, and scores 4–6 are categorized as flagged.



PSA FTA Risk Score	Total
1	3,981
2	2,744
3	2,570
4	2,482
5	1,721
6	1,351

PSA NCA Risk Score	Total
1	2,949
2	2,662
3	2,508
4	2,310
5	2,392
6	2,028

PSA NVCA Risk Score	Total
No flag	13,001
Flag	1,848

Table 8 shows the AUC values for the PSA subscales for each outcome of interest. The AUC value is a single number that represents the ability of the tool to discriminate between individuals who are lower or higher risk across the range of the tool. For criminal justice risk assessments, a common metric for evaluating AUC values is derived from Demarais and Singh (2013),[14] who defined AUC values less than 0.55 as poor, of 0.55–0.63 as fair, of 0.64–0.70 as good, and of 0.71–1.00 as excellent. By these definitions, the AUC values for the PSA are excellent for new arrest; good for new filing, new conviction, and FTA; and fair for new violent arrest.

The 95% confidence interval (CI) is also shown. It represents the range of AUC estimates that the true AUC value is 95% likely to fall between. A smaller range indicates that, given sample size and data

[14] Sarah L. Desmarais and Jay P. Singh, *Risk Assessment Instruments Validated and Implemented in Correctional Settings in the United States* (Lexington, KY: Council of State Governments, 2013).

pattern, the AUC can be estimated with greater precision. None of the 95% confidence intervals fall below the fair range.

Table 8. AUC Values by Adverse Outcome and PSA Subscale

Risk Score	Outcome	AUC	CI (95%)
PSA FTA	FTA	0.689	0.676-0.702
PSA NCA	New Arrest	0.748	0.74-0.755
PSA NCA	New Filing	0.705	0.695-0.715
PSA NCA	New Conviction	0.694	0.682-0.705
PSA NVCA	New Violent Arrest	0.585	0.573-0.597

[a] N = 14849

The following series of charts shows the rate of various adverse outcomes during the pretrial period at each risk category of the PSA, using each of the PSA subscales for the relevant outcomes. The PSA-FTA risk scale is used for the outcome of FTA. The PSA-NCA risk scale is used for the outcomes of new arrest, new filing, and new conviction. The PSA-NVCA risk flag is used for the outcome of new violent arrest. For each outcome of interest,[15] observed rates of the outcome generally increase as the assessed risk level increases. This pattern is consistent across all outcomes and risk levels, except for a slight dip in the FTA outcome at the highest level of risk.

[15] See the validation methodology section for definitions of each outcome of interest.

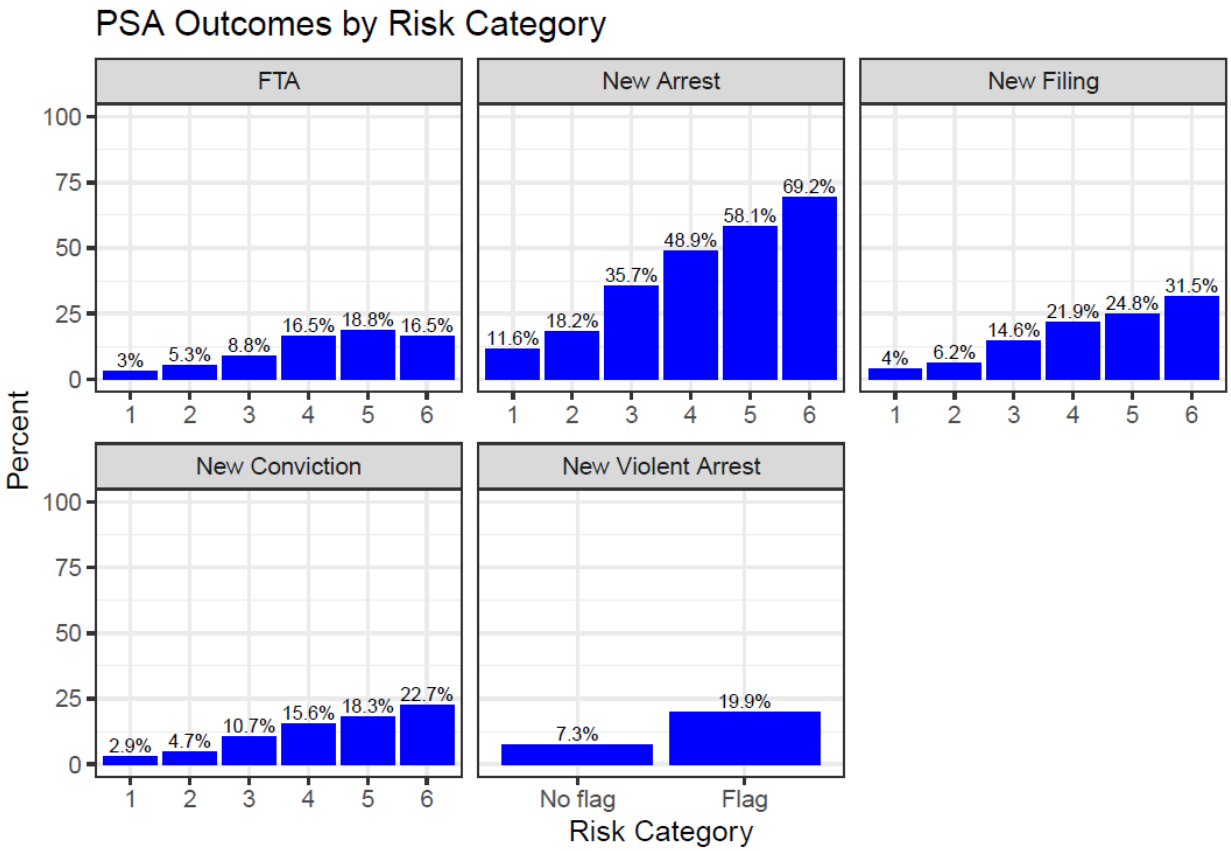


Table 9 shows the results from logistic regression models predicting each outcome of interest. The models control for the number of days the defendant spent released during the pretrial period. For each outcome of interest, the models show that the association between the relevant PSA risk score and the likelihood of the outcome during the pretrial period are statistically significant ($p<0.001$).

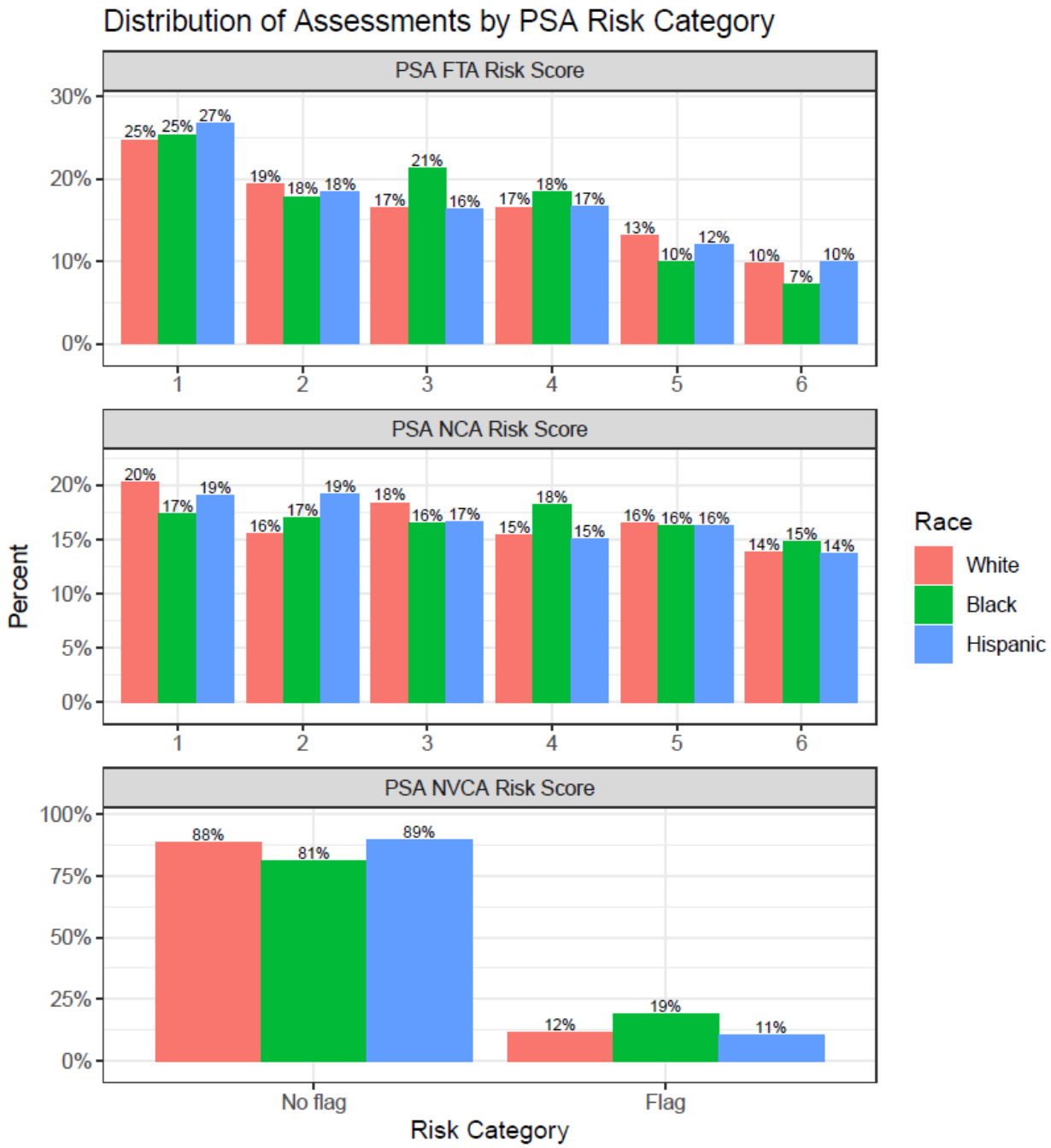
Table 9. Logistic Regression Models Testing the Probability of an Adverse Outcome Based on Risk Score and Days Released

	Dependent variable:				
	FTA	New Arrest	New Filing	New Conviction	New Violent Arrest
	(1)	(2)	(3)	(4)	(5)
PSA FTA Risk Score	0.393***				
	(0.017)				
PSA NCA Risk Score		0.601***	0.455***	0.421***	
		(0.013)	(0.015)	(0.017)	
PSA NVCA Risk Score					1.216***
					(0.069)
Days Released	0.001*	0.009***	0.007***	0.007***	0.007***
	(0.0004)	(0.0003)	(0.0003)	(0.0003)	(0.0004)
Constant	−3.645***	−3.575***	−4.219***	−4.408***	−3.332***
	(0.081)	(0.063)	(0.080)	(0.090)	(0.061)
Observations	14,849	14,849	14,849	14,849	14,849
Log Likelihood	−4,457.512	−7,877.591	−5,732.022	−4,803.486	−4,162.086
Akaike Inf. Crit.	8,921.024	15,761.180	11,470.040	9,612.971	8,330.172
Note:					*p<0.05; **p<0.01; ***p<.001

ANALYSIS OF PREDICTIVE BIAS

RACE/ETHNICITY

The following charts show the distribution of risk assessment scores by race/ethnicity. The distribution of scores varies by race/ethnicity most notably for NVCA score, with Black individuals receiving a new violent crime flag proportionately more frequently than white and Hispanic individuals.



PSA FTA Risk Score	White	Black	Hispanic
1	698	808	2,182
2	547	569	1,508
3	467	678	1,334
4	468	587	1,358
5	371	315	987
6	277	230	816

PSA NCA Risk Score	White	Black	Hispanic
1	574	552	1,561
2	439	541	1,572
3	520	525	1,363
4	437	579	1,235
5	466	518	1,331
6	392	472	1,123

PSA NVCA Risk Score	White	Black	Hispanic
No flag	2,502	2,579	7,320
Flag	326	608	865

The number of assessed individuals in each race/ethnicity group is sufficient to run statistical tests that look at how the PSA tool scales performed by race/ethnicity.

Table 10 shows the AUC values[16] and 95% confidence intervals for each outcome of interest and the relevant PSA risk subscale, separately, for each race/ethnicity group. All AUC values are in the fair to excellent range. Statistical testing[17] indicates that the AUC value for Hispanic individuals is statistically significantly higher compared to both white and Black individuals for the outcomes of new arrest and new conviction, and statistically significantly higher compared to white individuals for the outcome of new filing. This result indicates that, for these outcomes, the PSA NCA subscale has a better ability to distinguish between who are lower or higher risk for Hispanic individuals than for white or Black individuals. All other differences in AUC values are not statistically significant.

Table 10. AUC Values, by PSA Subscale, Adverse Outcome, and Race/Ethnicity

		AUC			CI (95%)		
Risk Score	Outcome	White	Black	Hispanic	White	Black	Hispanic
PSA FTA	FTA	0.702	0.679	0.682	0.676-0.728	0.652-0.706	0.663-0.701
PSA NCA	New Arrest	0.733	0.719	0.759	0.715-0.752	0.701-0.737	0.749-0.77
PSA NCA	New Filing	0.681	0.689	0.714	0.658-0.704	0.664-0.714	0.701-0.728
PSA NCA	New Conviction	0.666	0.671	0.706	0.638-0.693	0.641-0.7	0.691-0.721
PSA NVCA	New Violent Arrest	0.576	0.598	0.579	0.546-0.605	0.572-0.624	0.563-0.595

[a] N White = 2828 , N Black = 3187 , N Hispanic = 8185

The following series of charts shows the results of statistical models of the predictive power of the relevant PSA subscale for each outcome of interest by race/ethnicity group. The lines represent the probability of each outcome of interest at each risk level separately by race/ethnicity. The grey area around each line represents a 95% confidence interval: where the grey areas do not overlap, the evidence indicates there is likely a true difference between the groups; where the grey areas overlap, the evidence may not be strong enough to conclude that there are differences between groups.

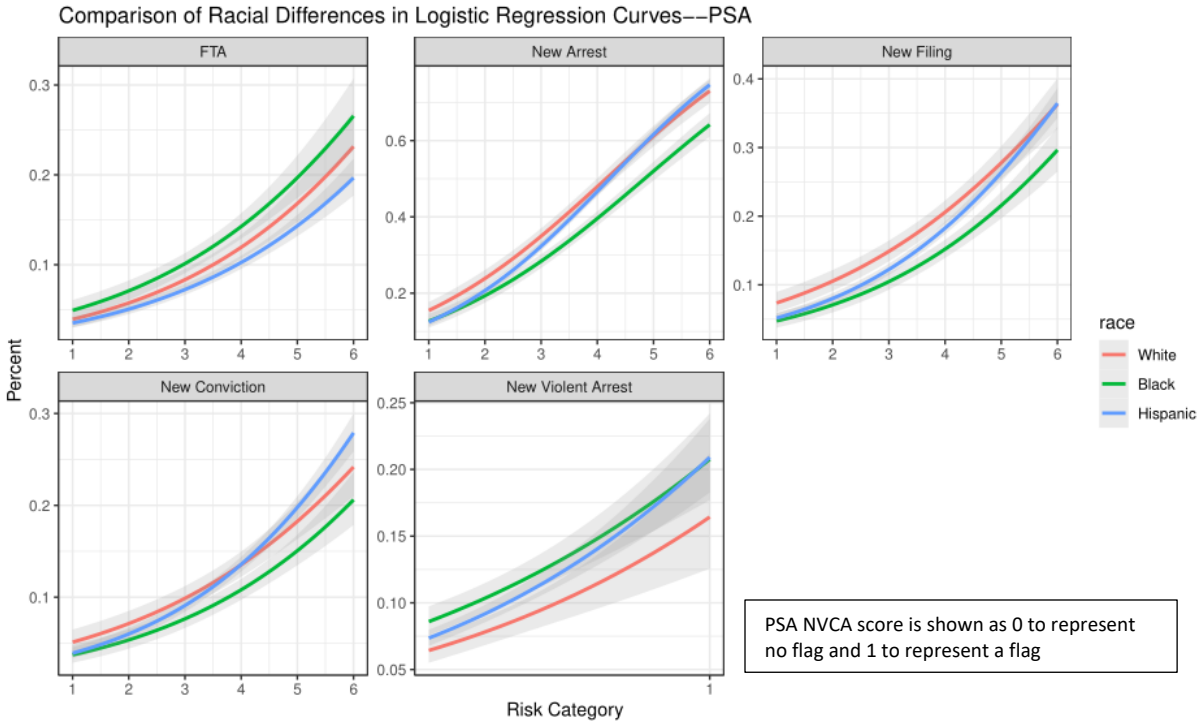
For FTA and new violent arrest, the confidence intervals of the lines for Black and Hispanic defendants overlap with those of the lines for white defendants, indicating that there is no evidence of a difference in the likelihood of those outcomes between Black or Hispanic individuals as compared to white individuals with the same score, at any risk level. The confidence intervals are notably wider for the new violent arrest outcome, because new violent arrest is a rarer outcome, which diminishes the ability of the model to make precise predictions.

For new arrest and new filing, the lack of overlap between the confidence intervals over some ranges of the tool indicates that there is evidence that for the middle and higher ranges of the tool, Black individuals have lower rates of new arrest and new filing than white or Hispanic individuals with the

[16] See General Validation, p. 10, for a description of the meaning of AUC values.

[17] DeLong's test for two ROC curves

same score. For new conviction, the confidence intervals largely overlap, except at risk level 4, where there is evidence that Black individuals have lower rates of new conviction than white or Hispanic individuals with risk level 4.



The patterns of outcomes by risk score and race/ethnicity were also examined across counties using the same tool. One large county showed a similar pattern as above, with new arrest and new filing showing evidence of differences by race/ethnicity across some ranges of the tool, while another large county showed no evidence of difference in these outcomes by race/ethnicity at any risk score.

Table 11 shows the results of a logistic regression that predicts each outcome of interest by the relevant PSA subscale risk score, race, and number of days spent released. Risk level on the relevant PSA subscale is in each case a statistically significant predictor of the outcome of interest. The number of days an individual was out on release also is a statistically significant predictor of all outcomes of interest, indicating that the longer an individual spends on release, the more likely the individual is to experience the outcomes of interest.

This statistical test compares Black and Hispanic individuals with white individuals. Black race is a statistically significant predictor of outcome of interest for new arrest, new filing, new conviction, and new violent arrest. For new arrest, new filing, and new conviction, Black race has a negative coefficient, indicating that Black individuals had a lower probability of those outcomes compared to white individuals with the same risk score. For new violent arrest, Black race has a positive coefficient, indicating that Black individuals had a higher probability of new violent arrest compared to white individuals with the same risk score.

Hispanic ethnicity is a statistically significant predictor of outcome of interest for FTA and new violent arrest. For FTA, Hispanic ethnicity has a negative coefficient, indicating that Hispanic individuals had a lower probability of FTA compared to white individuals with the same risk score. For new violent arrest, Hispanic ethnicity has a positive coefficient, indicating that Hispanic individuals had a higher probability of new violent arrest compared to white individuals with the same risk score.

This statistical test is limited, however, because it tests for an overall effect of race across the full risk scale, and as the above charts show, there appear to be different patterns across particular ranges of the tool subscales. Table 12 uses a more complex statistical model that allows for this possibility.

Table 11. Logistic Regression Models Testing the Probability of an Adverse Outcome Based on Risk Score, Race, and Days Released

	Dependent variable:				
	FTA	New Arrest	New Filing	New Conviction	New Violent Arrest
	(1)	(2)	(3)	(4)	(5)
PSA FTA Risk Score	0.391***				
	(0.018)				
PSA NCA Risk Score		0.598***	0.450***	0.416***	
		(0.013)	(0.015)	(0.017)	
PSA NVCA Risk Score					1.187***
					(0.070)
Race:Black	0.093	−0.261***	−0.285***	−0.180*	0.347***
	(0.084)	(0.061)	(0.075)	(0.085)	(0.093)
Race:Hispanic	−0.258***	−0.014	−0.081	0.071	0.196*
	(0.073)	(0.051)	(0.061)	(0.069)	(0.082)
Days Released	0.001*	0.009***	0.007***	0.007***	0.007***
	(0.0004)	(0.0003)	(0.0003)	(0.0004)	(0.0004)
Constant	−3.524***	−3.492***	−4.090***	−4.399***	−3.511***
	(0.101)	(0.076)	(0.094)	(0.107)	(0.092)
Observations	14,200	14,200	14,200	14,200	14,200
Log Likelihood	−4,272.749	−7,575.809	−5,545.331	−4,643.125	−4,036.568
Akaike Inf. Crit.	8,555.498	15,161.620	11,100.660	9,296.251	8,083.137
Note:					*p<0.05; **p<0.01; ***p<.001

Table 12 shows the results of a logistic regression that predicts each outcome of interest by the relevant PSA subscale risk score, race, the interaction between race and the PSA risk score, and number of days spent released. Risk score is a statistically significant predictor of each outcome of interest, as is the number of days spent released. This statistical test again compares Black and Hispanic individuals with white individuals.

The results indicate that there is no statistically significant interaction between Black race and the relevant PSA subscale risk scores on any of the outcomes of interest. There is, however, an interaction between Hispanic ethnicity and the PSA NCA risk score on new arrest, new filing, and new conviction, indicating that the effect of Hispanic ethnicity on these outcomes varies at different risk scores. The results indicate that Hispanic individuals have statistically significantly lower rates of new arrest and new filing at a PSA NCA score of 1, but that the rates of new arrest and new filing rise more for Hispanic individuals at each level of risk than for white individuals, and there is no statistically significant difference at a PSA NCA score of 6. For new conviction, there is no statistically significant difference between Hispanic and white individuals at a PSA NCA score of 1, but at a PSA NCA score of 6, the rate of new conviction for Hispanic individuals is statistically significantly higher than for white individuals.

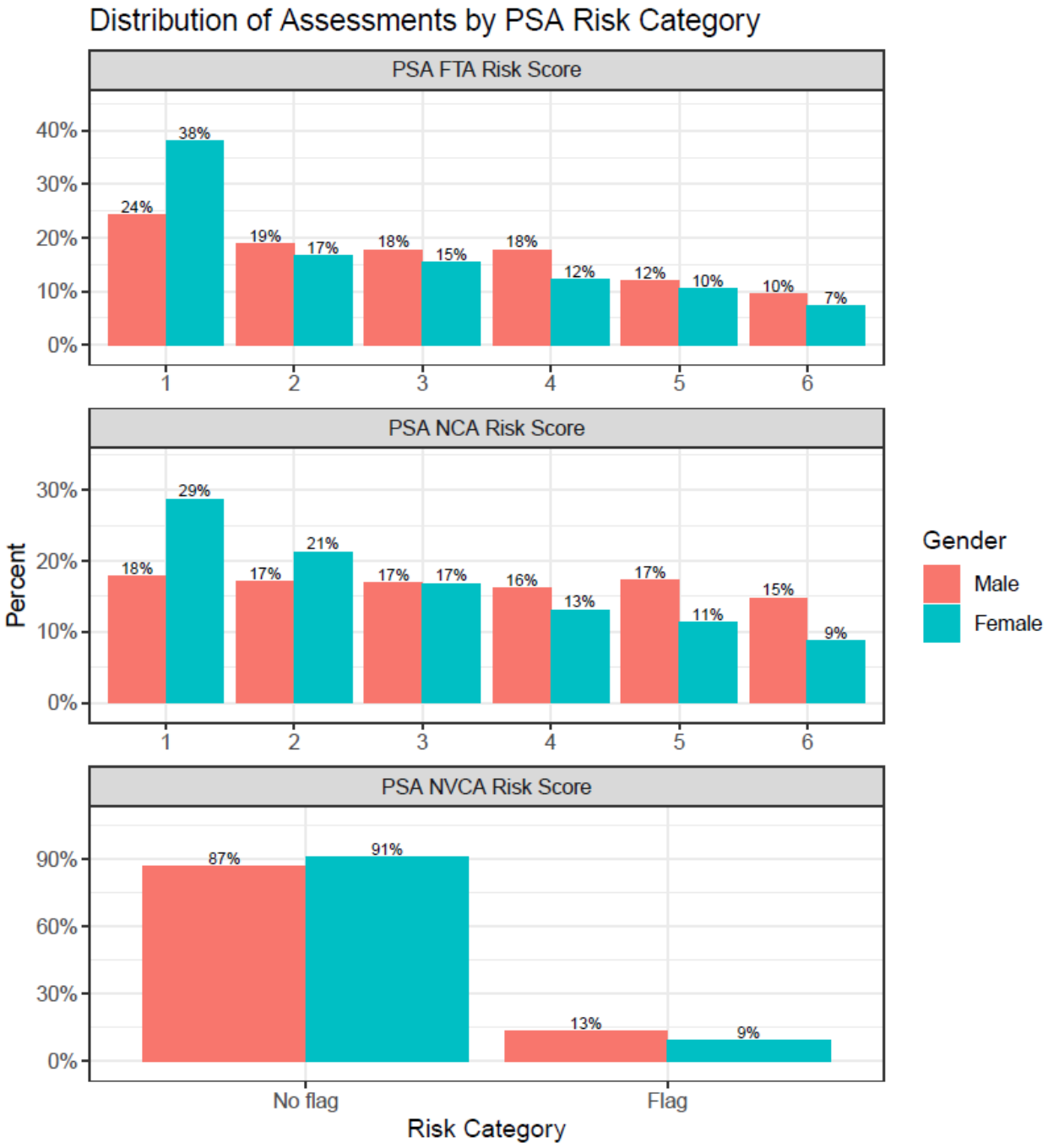
Table 12. Logistic Regression Models Testing the Probability of an Adverse Outcome Based on Risk Score, Days Released, Race, and Race by Risk Score Interaction

	Dependent variable:				
	FTA	New Arrest	New Filing	New Conviction	New Violent Arrest
	(1)	(2)	(3)	(4)	(5)
PSA FTA Risk Score	0.423***				
	(0.038)				
PSA NCA Risk Score		0.568***	0.402***	0.359***	
		(0.028)	(0.032)	(0.037)	
PSA NVCA Risk Score					1.177***
					(0.170)
Race:Black	0.219	−0.052	−0.366	−0.227	0.383***
	(0.217)	(0.155)	(0.210)	(0.241)	(0.108)
Race:Hispanic	−0.083	−0.267*	−0.385*	−0.307	0.178
	(0.191)	(0.127)	(0.166)	(0.191)	(0.093)
Days Released	0.001*	0.009***	0.007***	0.007***	0.007***
	(0.0004)	(0.0003)	(0.0003)	(0.0004)	(0.0004)
FTA*Black	−0.032				
	(0.053)				
FTA*Hispanic	−0.045				
	(0.045)				
NCA*Black		−0.052	0.021	0.013	
		(0.038)	(0.048)	(0.054)	
NCA*Hispanic		0.070*	0.075*	0.091*	
		(0.032)	(0.038)	(0.043)	
NVCA*Black					−0.103
					(0.211)
NVCA*Hispanic					0.084
					(0.196)
Constant	−3.649***	−3.388***	−3.895***	−4.161***	−3.509***
	(0.167)	(0.117)	(0.147)	(0.171)	(0.098)
Observations	14,200	14,200	14,200	14,200	14,200
Log Likelihood	−4,272.248	−7,567.789	−5,543.067	−4,640.182	−4,035.866
Akaike Inf. Crit.	8,558.495	15,149.580	11,100.130	9,294.365	8,085.732
Note:					*p<0.05; **p<0.01; ***p<.001

Further research is needed to analyze the elements that may be driving the observed differences and whether there are data-driven modifications to the tools' risk factors or weights that can further improve the predictive power of the tool.

GENDER

The following charts show the distribution of risk assessment scores by gender. The charts show a higher percentage of women than men with a low risk score for FTA and new criminal activity (NCA), and with no flag for new violent criminal activity (NCVA).



PSA FTA Risk Score	Male	Female
1	2,919	1,062
2	2,281	462
3	2,139	431
4	2,141	340
5	1,431	290
6	1,151	200

PSA NCA Risk Score	Male	Female
1	2,149	800
2	2,069	593
3	2,039	468
4	1,944	365
5	2,078	314
6	1,783	245

PSA NVCA Risk Score	Male	Female
No flag	10,465	2,534
Flag	1,597	251

The number of assessed individuals in each gender group is sufficient to run statistical tests that look at how the PSA tool scales performed by gender.

Table 13 shows the AUC values[18] and 95% confidence intervals for each outcome of interest and the relevant PSA risk subscale separately for women and men. All AUC values are in the fair to excellent range. Statistical testing[19] indicates that the AUC for women is statistically significantly higher than that for men for the outcomes of new filing, new conviction, and new violent arrest. This difference indicates that, for these outcomes, the PSA NCA and NVCA subscales have a better ability to distinguish between individuals who are lower or higher risk for women than for men.

Table 13. AUC Values, by PSA Subscale, Adverse Outcome, and Gender

		AUC		CI (95%)	
Risk Score	Outcome	Female	Male	Female	Male
PSA FTA	FTA	0.713	0.682	0.681-0.746	0.667-0.696
PSA NCA	New Arrest	0.759	0.740	0.739-0.779	0.732-0.749
PSA NCA	New Filing	0.747	0.692	0.72-0.774	0.681-0.703
PSA NCA	New Conviction	0.729	0.682	0.696-0.761	0.669-0.695
PSA NVCA	New Violent Arrest	0.621	0.578	0.587-0.654	0.564-0.591

[a] N Female = 2785 , N Male = 12062

The following series of charts shows the results of statistical models comparing the predictive power of the relevant PSA subscale for each outcome of interest for women and men. The lines represent the probability of each outcome of interest at each risk level separately for each gender. The grey area around each line represents a 95% confidence interval: where the grey areas do not overlap, the evidence indicates that there is likely a true difference between the groups; where the grey areas overlap, the evidence may not be strong enough to conclude that there are differences between them.

Across the outcomes of new arrest, new filing, and new conviction, the rate of each of these outcomes is lower for women than for men with the same PSA NCA risk score. The outcome of FTA shows the same pattern; however, the confidence intervals overlap, indicating that there may not be a statistically significant difference. For new violent arrest, women show a lower rate of this outcome when the PSA NVCA subscale indicates no new violent flag. When the tool indicates a violent flag, however, women

[18] See General Validation, p. 10, for a description of the meaning of AUC values.

[19] DeLong's test for two ROC curves

show a higher rate of new violent arrest, though the wide confidence interval indicates that, given the rarity of a violent flag among women combined with the low rates of new violent arrest overall, there may not be enough evidence to reliably indicate a true difference.

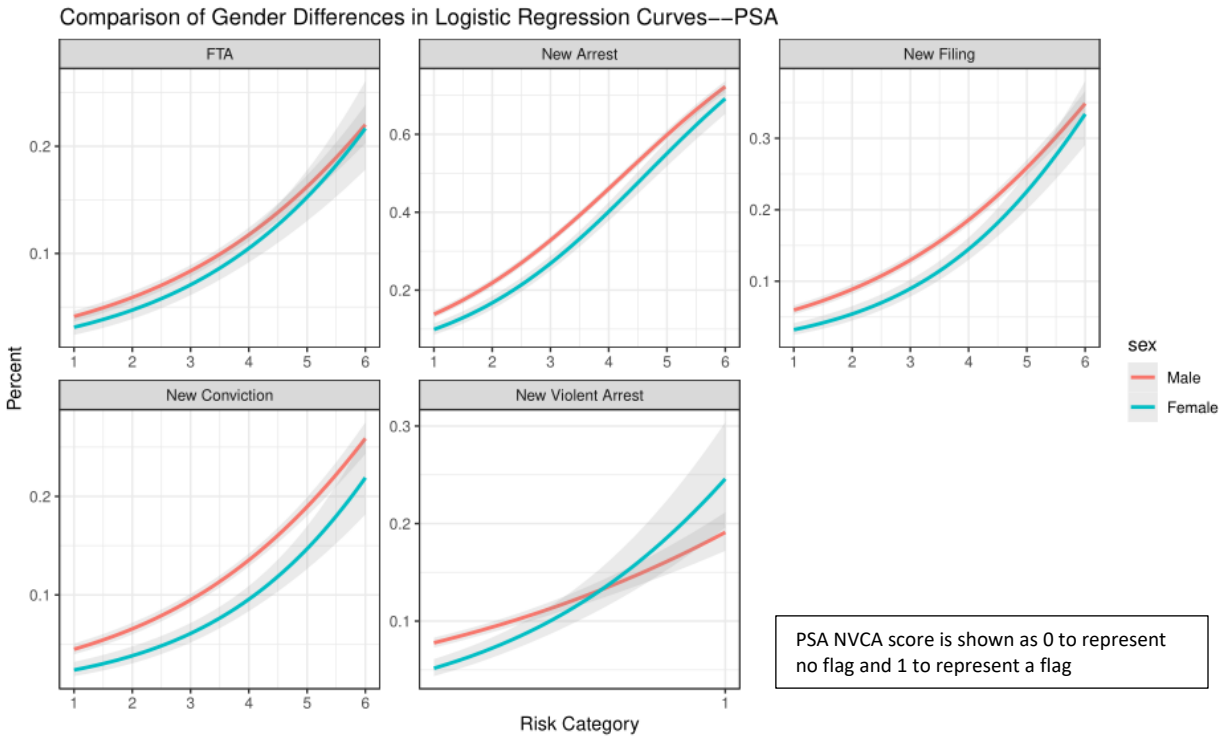


Table 14 shows the results of a logistic regression that predicts each outcome of interest by the relevant PSA subscale risk score, number of days spent released, and gender. This statistical test compares women with the base group of men. Risk level on the relevant PSA subscale is in each case a statistically significant predictor of the outcome of interest. The number of days the individual was out on release also is a statistically significant predictor of all the outcomes of interest, indicating that the longer an individual spends on release the more likely the individual is to experience the outcomes of interest.

Female gender is a statistically significant predictor of all outcomes of interest, indicating that for each outcome, women are statistically significantly less likely to experience the outcome of interest than men with the same risk score.

This statistical test is limited, however, because it tests for an overall effect of gender across the full risk scale and, as can be seen from the above charts, there appear to be different patterns for women than for men, especially for the new violent arrest outcome. Table 15 uses a more complex statistical model that allows for this possibility.

Table 14. Logistic Regression Models Testing the Probability of an Adverse Outcome Based on Risk Score, Days Released, and Gender

	Dependent variable:				
	FTA	New Arrest	New Filing	New Conviction	New Violent Arrest
	(1)	(2)	(3)	(4)	(5)
PSA FTA Risk Score	0.391***				
	(0.017)				
PSA NCA Risk Score		0.595***	0.449***	0.413***	
		(0.013)	(0.015)	(0.017)	
PSA NVCA Risk Score					1.206***
					(0.069)
Female	−0.164*	−0.253***	−0.288***	−0.390***	−0.231**
	(0.079)	(0.053)	(0.069)	(0.081)	(0.083)
Days Released	0.001*	0.009***	0.007***	0.007***	0.007***
	(0.0004)	(0.0003)	(0.0003)	(0.0003)	(0.0004)
Constant	−3.608***	−3.511***	−4.153***	−4.322***	−3.293***
	(0.083)	(0.064)	(0.082)	(0.091)	(0.063)
Observations	14,847	14,847	14,847	14,847	14,847
Log Likelihood	−4,455.083	−7,864.012	−5,720.422	−4,788.189	−4,155.098
Akaike Inf. Crit.	8,918.167	15,736.020	11,448.840	9,584.377	8,318.197
Note:					*p<0.05; **p<0.01; ***p<.001

Table 15 shows the results of a logistic regression that predicts each outcome of interest by the relevant PSA subscale risk score, gender, the interaction between gender and the PSA risk score, and number of days spent released. Risk score is a statistically significant predictor of each outcome of interest, as is the number of days spent released. This statistical test again compares women with men as the base group.

The results indicate that there is a statistically significant interaction between gender and risk score on new filing and new violent arrest, indicating that the impact of gender on these outcomes varies at different risk scores. The results indicate that women have statistically significantly lower rates of new filing at a PSA NCA score of 1, but that the rates of new filing rise slightly more at each level of risk for women than for men, so this gap gets smaller at higher scores and is not statistically significant at PSA NCA score 6. The pattern is stronger for new violent arrest, indicating that women have statistically significantly lower rates of new violent arrest than men when there is no new violent flag, but women have higher rates of new violent arrest when there is a violent flag, though this difference is not statistically significant.

Table 15. Logistic Regression Models Testing the Probability of an Adverse Outcome Based on Risk Score, Days Released, Gender, and Gender by Risk Score Interaction

	Dependent variable:				
	FTA	New Arrest	New Filing	New Conviction	New Violent Arrest
	(1)	(2)	(3)	(4)	(5)
PSA FTA Risk Score	0.384***				
	(0.019)				
PSA NCA Risk Score		0.590***	0.434***	0.404***	
		(0.014)	(0.016)	(0.018)	
PSA NVCA Risk Score					1.108***
					(0.075)
Female	−0.299	−0.359**	−0.673***	−0.643**	−0.392***
	(0.187)	(0.126)	(0.185)	(0.213)	(0.097)
Days Released	0.001*	0.009***	0.007***	0.007***	0.007***
	(0.0004)	(0.0003)	(0.0003)	(0.0003)	(0.0004)
FTA*Female	0.037				
	(0.046)				
NCA*Female		0.031	0.098*	0.064	
		(0.033)	(0.043)	(0.049)	
NVCA*Female					0.692***
					(0.191)
Constant	−3.583***	−3.492***	−4.090***	−4.283***	−3.267***
	(0.089)	(0.068)	(0.086)	(0.096)	(0.063)
Observations	14,847	14,847	14,847	14,847	14,847
Log Likelihood	−4,454.761	−7,863.579	−5,717.766	−4,787.335	−4,148.790
Akaike Inf. Crit.	8,919.522	15,737.160	11,445.530	9,584.670	8,307.581
Note:					*p<0.05; **p<0.01; ***p<.001

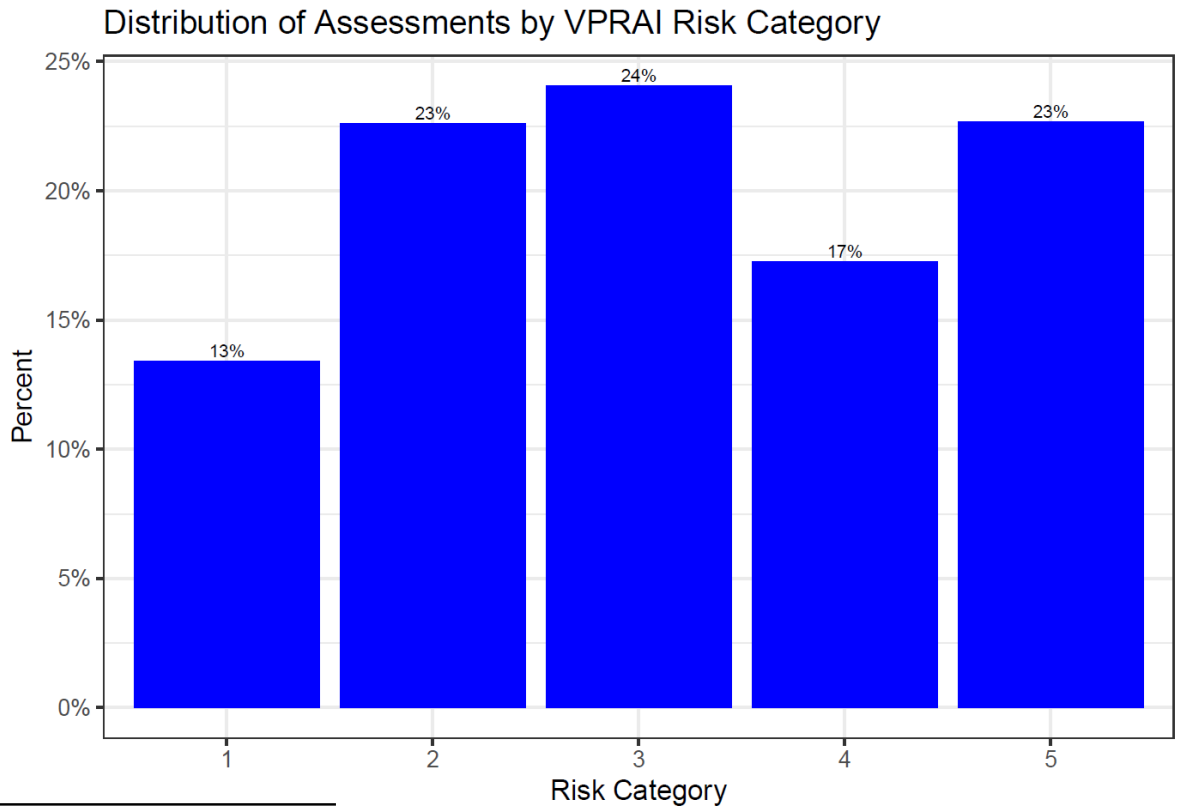
Further research is needed to analyze the elements that may be driving the observed differences and whether there are data-driven modifications to the tools' risk factors or weights that can further improve the predictive power of the tool.

VPRAI VALIDATION

GENERAL VALIDATION

The following chart shows the distribution of risk categories for individuals in the evaluation data set assessed with the VPRAI tool, used by the Pretrial Pilot Projects in San Joaquin and Santa Barbara Counties. The VPRAI tool developer divided the risk scores into five risk levels: risk level 1 includes scores 0–1, level 2 includes score 2, level 3 includes score 3, level 4 includes score 4, and level 5 includes scores 5–9.[9] Risk level 1 was the least common assessed risk level in the evaluation data set. The VPRAI was specifically designed to predict a composite of failure to appear (FTA), new arrest (NA), and technical violations.[20] The distribution of all assessed individuals may differ from the distribution in the evaluation data set because the evaluation data set includes only released individuals with concluded pretrial periods.

[20] The low quality of the data on technical violations prevented us from creating a composite failure rate that included FTA, new arrest, and technical violations. The composite measure in this report is a combination of the risk of FTA and the risk of new arrest.



VPRAI Risk Level	Total
1	925
2	1,560
3	1,660
4	1,190
5	1,565

Table 16 shows the AUC value for the VPRAI tool, using the five established risk levels, for each outcome of interest. The AUC value is a single number that represents the ability of the tool to discriminate between individuals who are lower or higher risk across the range of the tool. For criminal justice risk assessments, a common metric for evaluating AUC values is derived from Demarais and Singh (2013),[21] who defined AUC values less than 0.55 as poor, 0.55-0.63 as fair, 0.64-0.70 as good, and 0.71-1.00 as excellent. By these definitions, the AUC values for the VPRAI are good for FTA, new arrest, new filing, and new conviction, and fair for new violent arrest.

The 95% confidence interval—which represents the range of AUC estimates that the true AUC value is 95% likely to fall between—is also shown. A smaller range indicates that given the size of the sample and pattern of the data, the AUC is able to be estimated with greater precision. None of the 95% confidence intervals fall below the fair range.

[21] Demarais, *Risk Assessment Instruments*.

Table 16. AUC Values for the VPRAI, by Adverse Outcome

Outcome	AUC	CI (95%)
FTA	0.679	0.667-0.692
New Arrest	0.704	0.691-0.717
New Filing	0.679	0.664-0.695
New Conviction	0.667	0.647-0.686
New Violent Arrest	0.605	0.583-0.626
FTA or New Arrest	0.700	0.688-0.712

[a] N = 6900

The following series of charts shows the rate of various adverse outcomes during the pretrial period at each risk level of the VPRAI.[22] For each outcome of interest,[23] observed rates of the outcome increase consistently as the assessed risk level increases.

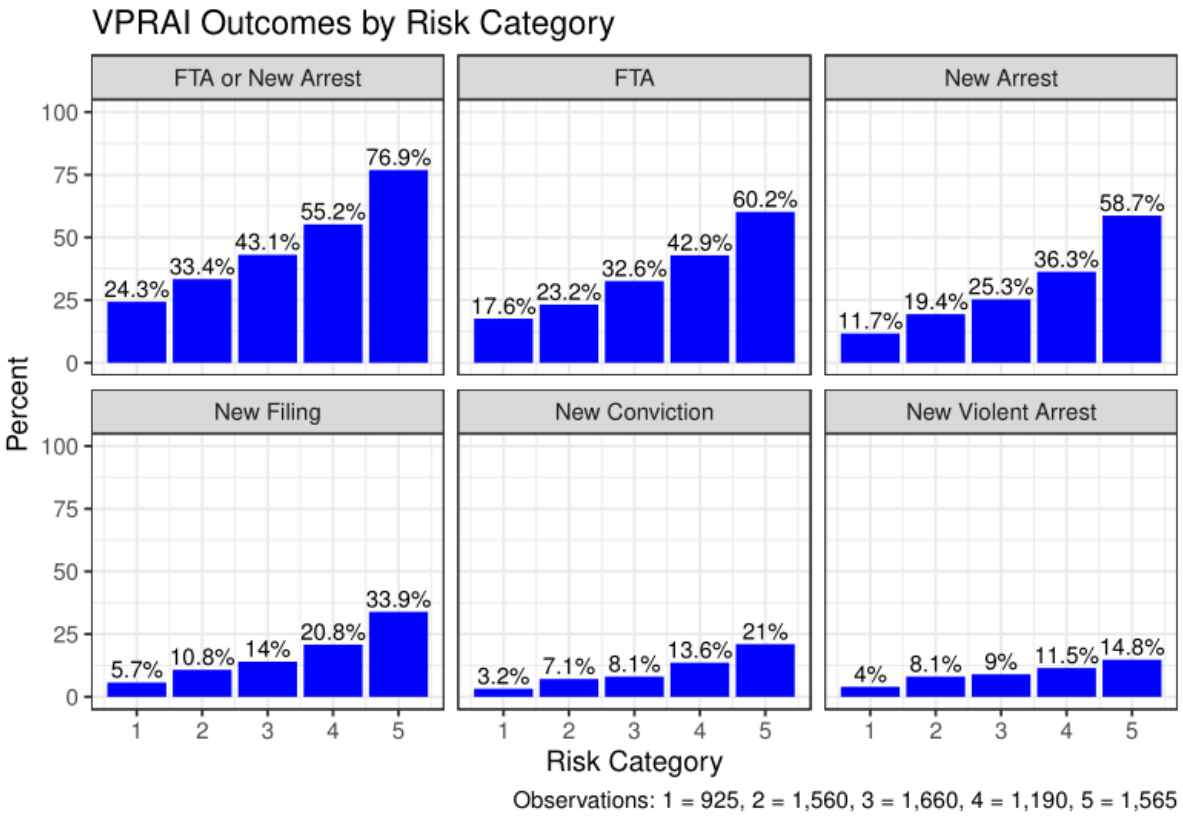


Table 17 shows the results from logistic regression models predicting each outcome of interest. The models control for the number of days the defendant spent released during the pretrial period. For each

[22] Risk levels are groupings of scores as defined by the tool developer.

[23] See the validation methodology section for definitions of each outcome of interest.

outcome of interest, the models show that the association between the VPRAI risk score and the likelihood of the outcome during the pretrial period is statistically significant (p<0.001).

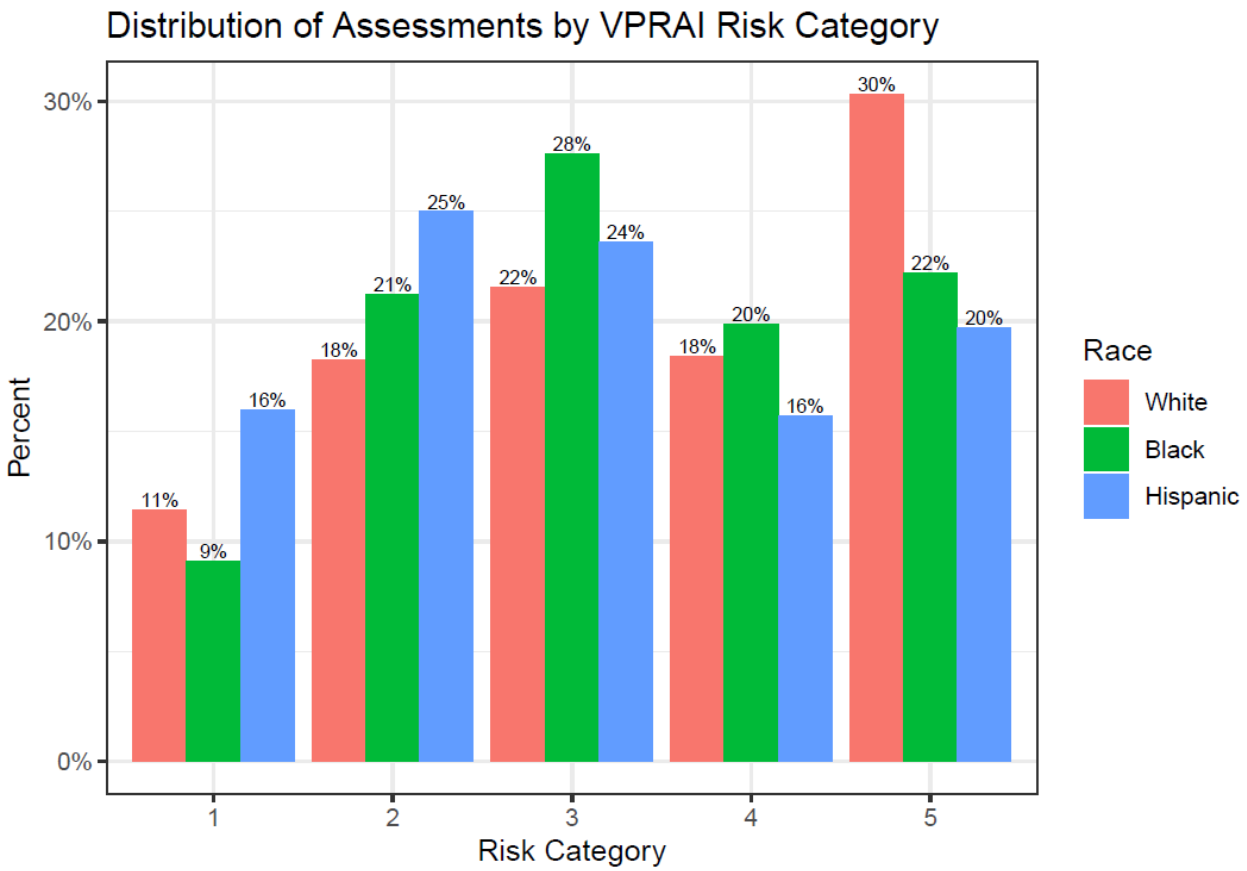
Table 17. Logistic Regression Models Testing the Probability of an Adverse Outcome Based on Risk Score and Days Released

	Dependent variable:					
	FTA	New Arrest	New Filing	New Conviction	New Violent Arrest	FTA or New Arrest
	(1)	(2)	(3)	(4)	(5)	(6)
VPRAI Risk Score	0.514***	0.666***	0.565***	0.514***	0.316***	0.598***
	(0.021)	(0.024)	(0.027)	(0.033)	(0.032)	(0.021)
Days Released	0.001***	0.004***	0.003***	0.003***	0.003***	0.002***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Constant	−2.388***	−3.605***	−4.016***	−4.375***	−3.772***	−2.263***
	(0.081)	(0.099)	(0.118)	(0.140)	(0.132)	(0.078)
Observations	6,900	6,900	6,900	6,900	6,900	6,900
Log Likelihood	−4,172.367	−3,655.580	−2,872.500	−2,184.268	−2,095.344	−4,251.431
Akaike Inf. Crit.	8,350.733	7,317.161	5,751.001	4,374.535	4,196.688	8,508.862
Note:						*p<0.05; **p<0.01; ***p<.001

ANALYSIS OF PREDICTIVE BIAS

RACE/ETHNICITY

The following chart shows the distribution of risk assessment scores by race/ethnicity. The distribution of scores varies by race/ethnicity, with white individuals assessed more frequently in the highest category of risk while Black and Hispanic individuals more commonly received scores in the midrange of the risk tool.



VPRAI Risk Score	White	Black	Hispanic
1	220	128	466
2	352	299	730
3	416	389	689
4	355	280	459
5	585	313	576

The number of assessed individuals in each race/ethnicity group is sufficient to run statistical tests that look at how the tool performed by race/ethnicity.

Table 18 shows the AUC values[24] and 95% confidence intervals for each outcome of interest separately for each race/ethnicity group. All AUC values are in the fair to excellent range. Statistical testing[25] indicates that the AUC for the Black racial group is statistically significantly lower than the AUC for the white and Hispanic groups for the outcomes of FTA, new arrest, new filing, and FTA or new arrest. The AUC for the Black racial group is statistically significantly lower compared to the AUC for the Hispanic group but not the white group for the outcome of new conviction. This result indicates that, for Black individuals, the VPRAI has a poorer ability to distinguish between individuals who are lower or higher

[24] See General Validation, p. 10, for a description of the meaning of AUC values.

[25] DeLong's test for two ROC curves

risk for some outcomes. Black individuals are also the smallest group of assessed individuals for this tool, resulting in generally larger confidence intervals around the AUC. The larger confidence intervals are an indication of the difficulty in getting a precise estimate given the smaller sample size.

Table 18. AUC Values for the VPRAI, by Adverse Outcome and Race/Ethnicity

	AUC			CI (95%)		
Outcome	White	Black	Hispanic	White	Black	Hispanic
FTA	0.695	0.612	0.682	0.671-0.718	0.583-0.641	0.662-0.703
New Arrest	0.721	0.651	0.707	0.698-0.744	0.621-0.68	0.687-0.728
New Filing	0.678	0.617	0.695	0.651-0.706	0.581-0.653	0.67-0.72
New Conviction	0.656	0.608	0.684	0.622-0.689	0.562-0.654	0.653-0.714
New Violent Arrest	0.609	0.576	0.627	0.567-0.652	0.534-0.618	0.595-0.66
FTA or New Arrest	0.725	0.635	0.701	0.703-0.747	0.607-0.663	0.682-0.719

[a] N White = 1928 , N Black = 1409 , N Hispanic = 2920

The following series of charts shows the results of statistical models of the predictive power of the tool for each race/ethnicity group. Each line represents the probability of each outcome of interest at each risk level separately for each race/ethnicity. The grey area around each line represents a 95% confidence interval: where the grey areas do not overlap, the evidence indicates that there is likely a true difference between the groups; where the grey areas overlap, the evidence is not strong enough to conclude that there are differences between them. For new arrest, new filing, and new conviction, the confidence intervals of the lines overlap, indicating that there is no evidence of a difference in the likelihood of those outcomes for individuals of different race/ethnic groups with the same score, at any risk level. The confidence intervals are notably wider for the new violent arrest outcome because new violent arrest is a rarer outcome, which diminishes the ability of the model to make precise predictions. Nevertheless, the lack of overlap between the confidence intervals in the midrange of the tool indicates that there is evidence that, for risk levels 2–4, Black individuals receiving this score have higher rates of new violent arrest than white or Hispanic individuals with the same score. Similarly, for the outcome of FTA and the combined outcome of FTA or New Arrest, for risk levels 2–4, evidence shows that Black individuals receiving this score have higher rates of FTA and FTA or new arrest than white or Hispanic individuals receiving the same score.

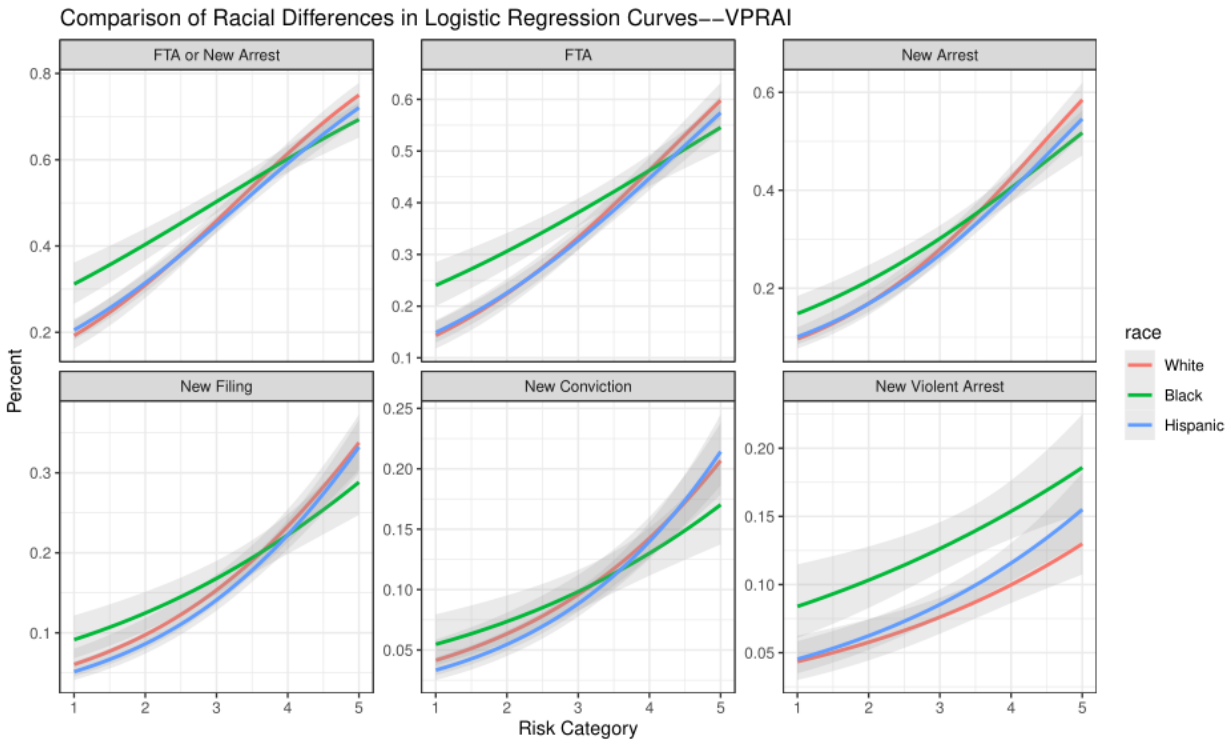


Table 19 shows the results of a logistic regression that predicts each outcome of interest by VPRAI risk score, number of days spent released, and race. Risk score is a statistically significant predictor of each outcome of interest. This statistical test compares Black and Hispanic individuals with white individuals. The only outcome where the difference was statistically significant was for new violent arrest, for which Black race predicted a greater likelihood of new violent arrest beyond what was predicted by the risk score. This statistical test is limited, however, because it tests for an overall effect of race across the full risk scale, and as can be seen from the above charts, some differences appear to emerge only in particular ranges of the tool. Table 20 uses a more complex statistical model that allows for this possibility.

Table 19. Logistic Regression Models Testing the Probability of an Adverse Outcome Based on Risk Score, Days Released, and Race

	Dependent variable:					
	FTA	New Arrest	New Filing	New Conviction	New Violent Arrest	FTA or New Arrest
	(1)	(2)	(3)	(4)	(5)	(6)
VPRAI Risk Score	0.493***	0.658***	0.550***	0.493***	0.332***	0.583***
	(0.022)	(0.025)	(0.029)	(0.034)	(0.034)	(0.022)
Race:Black	0.113	−0.023	−0.022	−0.080	0.532***	0.110
	(0.075)	(0.081)	(0.094)	(0.113)	(0.114)	(0.076)
Race:Hispanic	−0.056	−0.097	−0.080	−0.040	0.155	−0.062
	(0.064)	(0.070)	(0.081)	(0.096)	(0.106)	(0.064)
Days Released	0.001***	0.004***	0.003***	0.003***	0.003***	0.002***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Constant	−2.306***	−3.528***	−3.909***	−4.245***	−4.018***	−2.203***
	(0.098)	(0.116)	(0.137)	(0.163)	(0.164)	(0.096)
Observations	6,257	6,257	6,257	6,257	6,257	6,257
Log Likelihood	−3,821.158	−3,338.017	−2,641.428	−2,011.525	−1,916.117	−3,864.641
Akaike Inf. Crit.	7,652.316	6,686.033	5,292.856	4,033.051	3,842.233	7,739.281
Note:						*p<0.05; **p<0.01; ***p<.001

Table 20 shows the results of a logistic regression that predicts each outcome of interest by VPRAI risk score, race, the interaction between race and the VPRAI risk score, and number of days spent released. Risk score is a statistically significant predictor of each outcome of interest. This statistical test compares Black and Hispanic individuals with white individuals. It shows the same result as above for new violent arrest—that Black race predicts higher new violent arrest on average across the full scale of the tool. The added complexity to the model indicates that the interaction between Black race and VPRAI risk score is statistically significant for the outcomes of FTA, new arrest, new filing, and FTA or new arrest. The statistically significant interaction means that the impact of Black race on the outcome of interest varies at different risk scores because the increase in these outcome rates at each subsequent risk score is smaller for Black individuals than for white individuals. The results indicate that at low risk scores, Black race predicts a statistically significantly greater likelihood of FTA, new arrest, and FTA or new arrest than does white race at the same risk score, and a nonsignificant difference for new filing. At a VPRAI risk score of 6, however, Black race predicts a statistically significantly lower likelihood of FTA, new arrest, new filing, and FTA or new arrest.

Table 20. Logistic Regression Models Testing the Probability of an Adverse Outcome Based on Risk Score, Days Released, Race, and Race by Risk Score Interaction

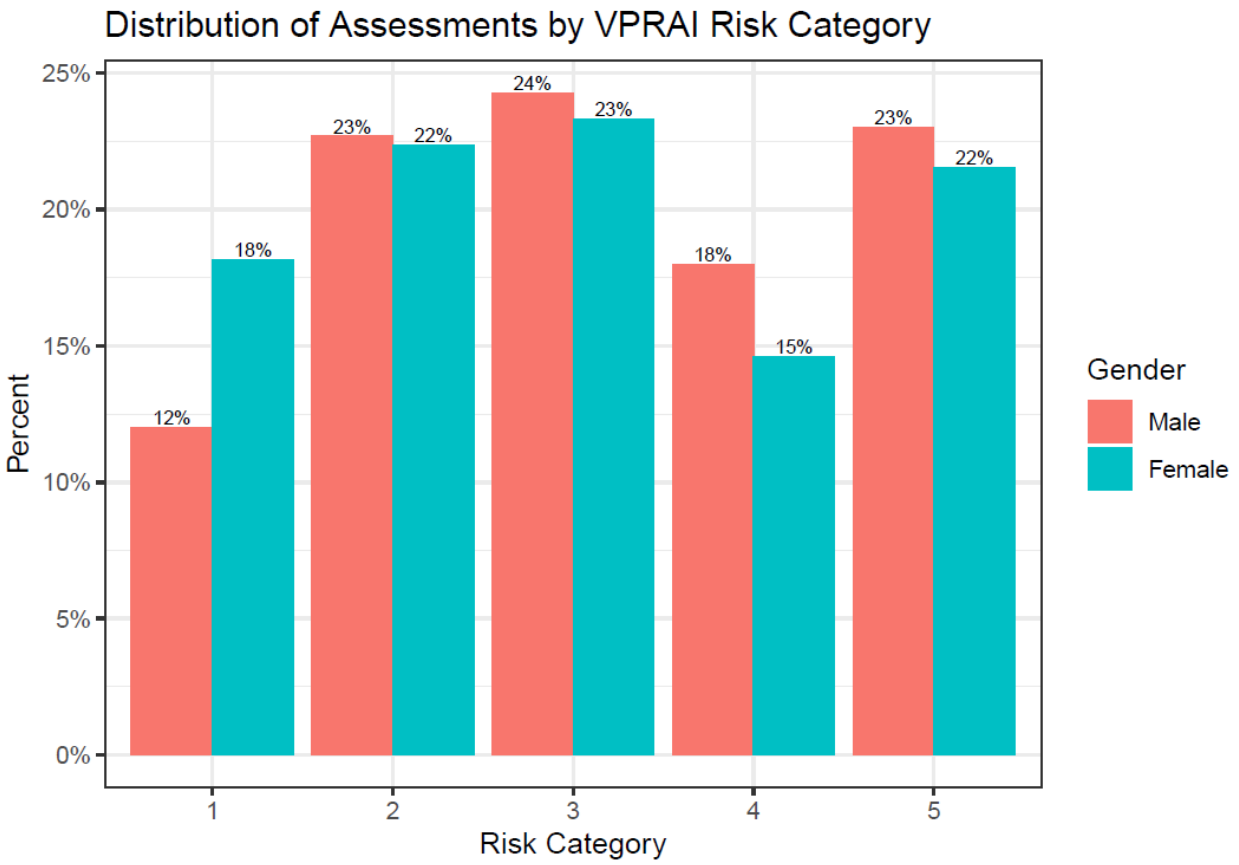
	Dependent variable:					
	FTA	New Arrest	New Filing	New Conviction	New Violent Arrest	FTA or New Arrest
	(1)	(2)	(3)	(4)	(5)	(6)
VPRAI Risk Score	0.557***	0.727***	0.569***	0.487***	0.328***	0.662***
	(0.039)	(0.044)	(0.050)	(0.059)	(0.064)	(0.039)
Race:Black	0.634***	0.491*	0.426	0.259	0.687*	0.649***
	(0.165)	(0.192)	(0.230)	(0.282)	(0.269)	(0.157)
Race:Hispanic	0.050	0.063	−0.172	−0.226	0.050	0.088
	(0.140)	(0.162)	(0.200)	(0.240)	(0.242)	(0.131)
Days Released	0.001***	0.004***	0.003***	0.003***	0.003***	0.002***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
VPRAI*Black	−0.213***	−0.198**	−0.167*	−0.126	−0.061	−0.236***
	(0.060)	(0.067)	(0.077)	(0.093)	(0.091)	(0.060)
VPRAI*Hispanic	−0.037	−0.057	0.038	0.069	0.042	−0.060
	(0.050)	(0.056)	(0.065)	(0.077)	(0.081)	(0.050)
Constant	−1.979***	−3.061***	−3.416***	−3.734***	−3.677***	−1.810***
	(0.118)	(0.139)	(0.166)	(0.197)	(0.206)	(0.112)
Observations	6,257	6,257	6,257	6,257	6,257	6,257
Log Likelihood	−3,814.104	−3,333.494	−2,637.325	−2,009.063	−1,915.318	−3,856.520
Akaike Inf. Crit.	7,642.209	6,680.987	5,288.651	4,032.127	3,844.636	7,727.041

Note: *p<0.05; **p<0.01; ***p<.001

Further research is needed to analyze the elements that may be driving the observed differences and whether there are data-driven modifications to the tools' risk factors or weights that can further improve the predictive power of the tool.

GENDER

The following chart shows the distribution of risk assessment scores by gender. The distribution of risk scores for women is concentrated in the lower risk categories as compared with the risk scores for men.



VPRAI Risk Score	Male	Female
1	639	286
2	1,208	352
3	1,293	367
4	958	230
5	1,226	339

The number of assessed individuals in each gender group is sufficient to run statistical tests that look at how the VPRAI tool scales performed by gender.

Table 21 shows the AUC values[16] and 95% confidence intervals for each outcome of interest and VPRAI risk score separately for women and men. All AUC values are in the fair to excellent range. Statistical testing[26] indicates that there is no evidence of a statistically significant difference between the AUCs for women as compared to men.

[26] DeLong's test for two ROC curves

Table 21. AUC values for the VPRAI, by Adverse Outcome and Gender

	AUC		CI (95%)	
Outcome	Female	Male	Female	Male
FTA	0.694	0.676	0.668-0.72	0.661-0.691
New Arrest	0.706	0.703	0.679-0.734	0.688-0.718
New Filing	0.686	0.677	0.651-0.722	0.659-0.694
New Conviction	0.678	0.663	0.632-0.723	0.641-0.684
New Violent Arrest	0.603	0.604	0.556-0.65	0.58-0.627
FTA or New Arrest	0.711	0.696	0.686-0.736	0.683-0.71

[a] N Female = 1574 , N Male = 5324

The following series of charts shows the results of statistical models of the predictive power of the relevant VPRAI subscale for each outcome of interest for women and men. Each line represents the probability of each outcome of interest at each risk level separately for each gender. The grey area around each line represents a 95% confidence interval: where the grey areas do not overlap, the evidence indicates that a true difference between the groups is likely; where the grey areas overlap, the evidence may not be strong enough to conclude that there are differences between them.

Across the outcomes of new arrest, new filing, new conviction, and new violent arrest, the rate of each of these outcomes is lower for women than for men with the same VPRAI risk score; however, the confidence intervals overlap in some areas, which indicates a need to test whether the difference is statistically significant. The outcome of FTA shows the opposite pattern, again with some areas of overlapping confidence intervals. The outcome of FTA or new arrest shows no evidence of difference between women and men with the same VPRAI risk score.

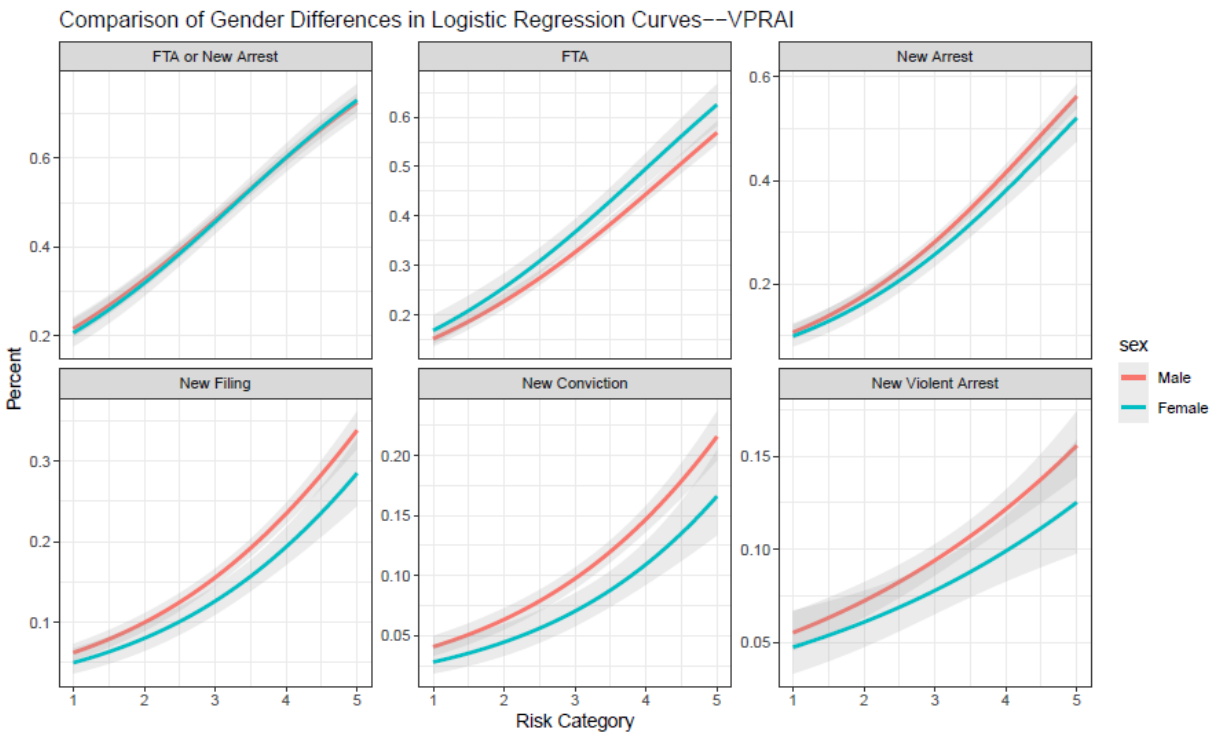


Table 22 shows the results of a logistic regression that predicts each outcome of interest by the relevant VPRAI risk score, gender, and number of days spent released. This statistical test compares women with the base group of men. Risk level on the relevant VPRAI score is a statistically significant predictor of the outcome of interest. The number of days the individual was out on release also is a statistically significant predictor of all the outcomes of interest, indicating that the longer an individual spends on release, the more likely the individual is to experience the outcomes of interest.

Female gender is a statistically significant predictor of all the outcomes of interest except for FTA or new arrest, indicating that for new arrest, new filing, new conviction, and new violent arrest, women are statistically significantly less likely to experience the outcome of interest than men with the same risk score. For FTA this pattern is reversed. Women are statistically significantly more likely to fail to appear than men with the same risk score. The difference between women and men for the outcome of FTA or new arrest is not statistically significant.

This statistical test is limited, however, because it tests for an overall effect of gender across the full risk scale, and patterns may be different for women than men across different ranges of the tool. Table 23 uses a more complex statistical model that allows for this possibility.

Table 22. Logistic Regression Models Testing the Probability of an Adverse Outcome Based on Risk Score, Days Released, and Gender

	Dependent variable:					
	FTA	New Arrest	New Filing	New Conviction	New Violent Arrest	FTA or New Arrest
	(1)	(2)	(3)	(4)	(5)	(6)
VPRAI Risk Score	0.517***	0.664***	0.563***	0.511***	0.313***	0.597***
	(0.021)	(0.024)	(0.027)	(0.033)	(0.032)	(0.021)
Female	0.180**	−0.177*	−0.294***	−0.393***	−0.259*	−0.031
	(0.063)	(0.070)	(0.085)	(0.105)	(0.105)	(0.063)
Days Released	0.001***	0.004***	0.003***	0.003***	0.003***	0.002***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Constant	−2.438***	−3.563***	−3.952***	−4.293***	−3.713***	−2.254***
	(0.083)	(0.100)	(0.119)	(0.142)	(0.134)	(0.080)
Observations	6,898	6,898	6,898	6,898	6,898	6,898
Log Likelihood	−4,166.668	−3,650.890	−2,865.836	−2,176.522	−2,089.720	−4,250.208
Akaike Inf. Crit.	8,341.336	7,309.779	5,739.673	4,361.043	4,187.440	8,508.415
Note:						*p<0.05; **p<0.01; ***p<.001

Table 23 shows the results of a logistic regression that predicts each outcome of interest by VPRAI risk score, gender, the interaction between gender and the VPRAI risk score, and number of days spent released. Risk score is a statistically significant predictor of each outcome of interest, as is the number of days spent released. This statistical test again compares women with men as the base group.

The results show no evidence of a statistically significant interaction between gender and risk score for any outcome. In the absence of a statistically significant interaction, the above model with no interaction is more appropriate to demonstrate the impact of gender.

Table 23. Logistic Regression Models Testing the Probability of an Adverse Outcome Based on Risk Score, Days Released, Gender, and Gender by Risk Score Interaction

	Dependent variable:					
	FTA	New Arrest	New Filing	New Conviction	New Violent Arrest	FTA or New Arrest
	(1)	(2)	(3)	(4)	(5)	(6)
VPRAI Risk Score	0.510***	0.668***	0.564***	0.509***	0.319***	0.591***
	(0.024)	(0.027)	(0.031)	(0.036)	(0.036)	(0.024)
Female	0.115	−0.135	−0.285	−0.429	−0.193	−0.081
	(0.125)	(0.150)	(0.193)	(0.246)	(0.216)	(0.118)
Days Released	0.001***	0.004***	0.003***	0.003***	0.003***	0.002***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
VPRAI*Female	0.029	−0.017	−0.004	0.013	−0.027	0.024
	(0.048)	(0.054)	(0.065)	(0.082)	(0.077)	(0.048)
Constant	−1.904***	−2.909***	−3.391***	−3.775***	−3.415***	−1.645***
	(0.071)	(0.086)	(0.102)	(0.121)	(0.115)	(0.068)
Observations	6,898	6,898	6,898	6,898	6,898	6,898
Log Likelihood	−4,166.489	−3,650.839	−2,865.835	−2,176.509	−2,089.658	−4,250.086
Akaike Inf. Crit.	8,342.977	7,311.678	5,741.670	4,363.018	4,189.315	8,510.172

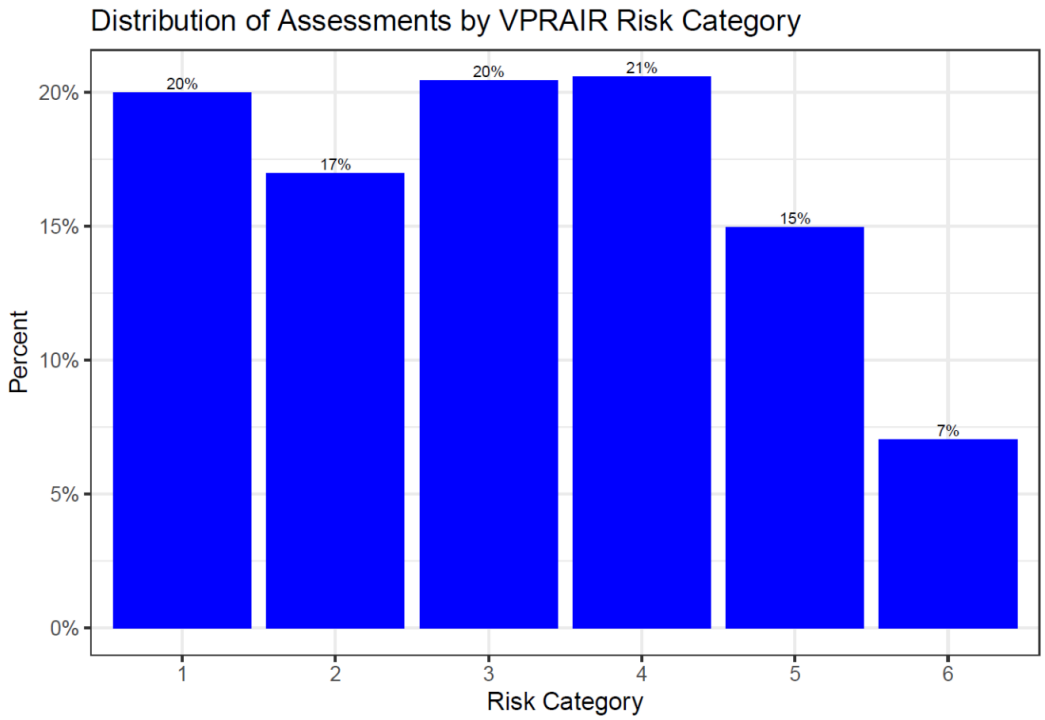
Note: *p<0.05; **p<0.01; ***p<.001

Further research is needed to analyze the elements that may be driving the observed differences and whether there are data-driven modifications to the tools' risk factors or weights that can further improve the predictive power of the tool.

VPRAI-R VALIDATION

GENERAL VALIDATION

The following chart shows the distribution of risk levels for individuals in the evaluation data set assessed with the VPRAI-R tool, used by the Pretrial Pilot Projects in Alameda, San Mateo, and Santa Barbara Counties. The VPRAI-R tool developer divided the risk scores into six risk categories: level 1 includes scores 0–2; level 2, scores 3–4; level 3, scores 5–6; level 4, scores 7–8; level 5, scores 9–10; and level 6, scores 11–14. Risk category six was the least frequent level assessed in the evaluation data set. The VPRAI-R was specifically designed to predict a composite of failure to appear (FTA), new arrest (NA), and technical violations.[27] The distribution of all assessed individuals may differ from the distribution in the evaluation data set because the evaluation data set includes only released individuals with concluded pretrial periods.



[27]The low quality of the data on technical violations prevented the creation of a composite failure rate that included FTA, new arrest, and technical violations. The composite measure in this report is a combination of the risk of FTA and the risk of new arrest.

VPRAIR Risk Level	Total
1	139
2	118
3	142
4	143
5	104
6	49

Table 24 shows the AUC value for the VPRAI-R tool, using the six established risk levels, for each outcome of interest. The AUC value is a single number that represents the ability of the tool to discriminate between individuals who are lower or higher risk across the range of the tool. For criminal justice risk assessments, a common metric for evaluating AUC values is derived from Demarais and Singh (2013),[28] who defined AUC values less than 0.55 as poor, 0.55–0.63 as fair, 0.64–0.70 as good, and 0.71–1.00 as excellent. By these definitions, the AUC values for the VPRAI-R are excellent for FTA, new arrest, and FTA or new arrest and good for new filing, new conviction, and new violent arrest.

The 95% confidence interval—which represents the range of AUC estimates that the true AUC value is 95% likely to fall between—is also shown. A smaller range indicates that, given the size of the sample and pattern of the data, the AUC can be estimated with greater precision. None of the 95% confidence intervals fall below the fair range.

Table 24. AUC Values for the VPRAI-R, by Adverse Outcome

Outcome	AUC	CI (95%)
FTA	0.719	0.673-0.765
New Arrest	0.726	0.688-0.763
New Filing	0.669	0.622-0.716
New Conviction	0.643	0.584-0.701
New Violent Arrest	0.640	0.579-0.702
FTA or New Arrest	0.757	0.722-0.792

[a] N = 695

The following series of charts shows the rate of various adverse outcomes during the pretrial period at each risk level of the VPRAI-R.[29] For each outcome of interest,[30] observed rates of the outcome generally increase as the assessed risk level increases, but the pattern is not consistent across all outcomes and risk levels. For example, rates of new arrest increase consistently across the full range of risk levels, but rates of new filings do not follow this pattern at the upper end of the scale. The highest risk level has a

[28] Demarais, *Risk Assessment Instruments*.

[29] Risk levels are groupings of scores as defined by the tool developer.

[30] See validation methodology section for definitions of each outcome of interest.

small sample size (n=49), and the observed outcome rates at this risk level may not be a reliable estimate for the population.

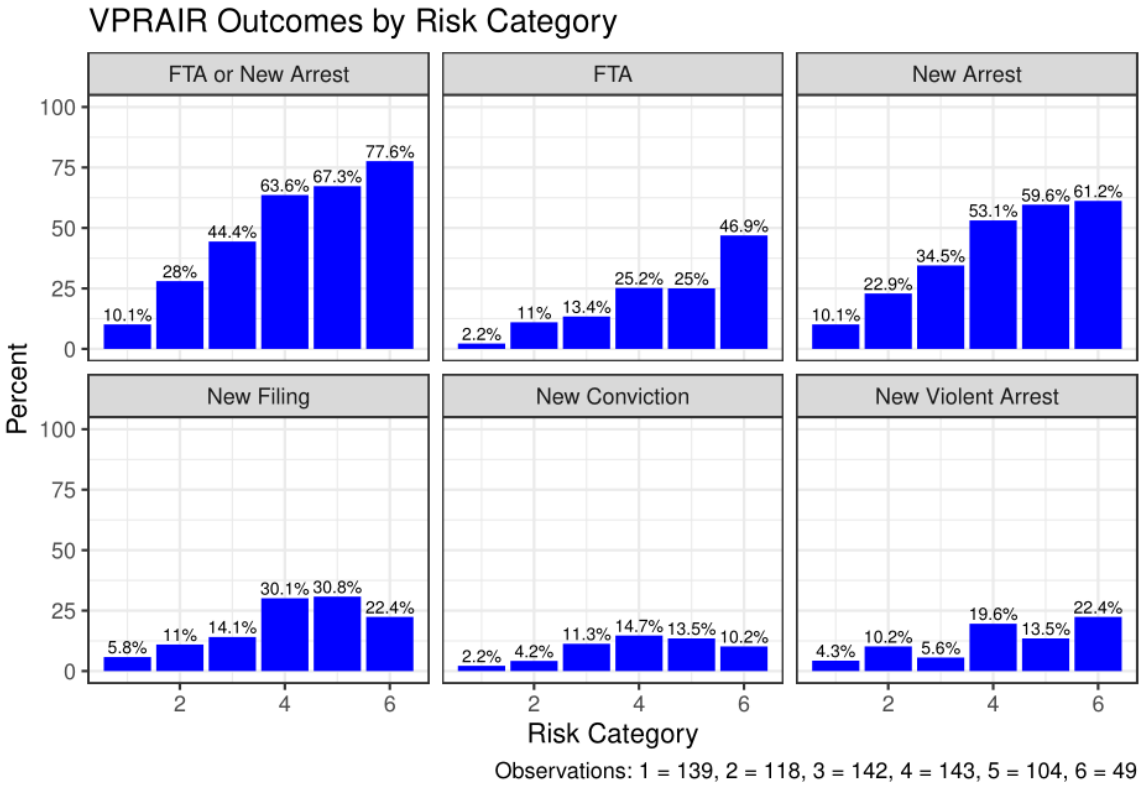


Table 25 shows the results from logistic regression models predicting each outcome of interest. The models control for the number of days the defendant spent released during the pretrial period. For each outcome of interest, the models show that the association between VPRAI-R risk score and the likelihood of the outcome during the pretrial period is statistically significant ($p<0.001$).

Table 25. Logistic Regression Models Testing the Probability of an Adverse Outcome Based on Risk Score and Days Released

	Dependent variable:					
	FTA	New Arrest	New Filing	New Conviction	New Violent Arrest	FTA or New Arrest
	(1)	(2)	(3)	(4)	(5)	(6)
VPRAIR Risk Score	0.548***	0.597***	0.376***	0.302***	0.306***	0.698***
	(0.075)	(0.064)	(0.069)	(0.089)	(0.083)	(0.065)
Days Released	0.001	0.013***	0.007***	0.004*	0.009***	0.010***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	−3.558***	−3.429***	−3.338***	−3.618***	−3.860***	−3.159***
	(0.323)	(0.288)	(0.311)	(0.373)	(0.378)	(0.274)
Observations	695	695	695	695	695	695
Log Likelihood	−288.077	−374.341	−302.691	−204.208	−223.984	−384.156
Akaike Inf. Crit.	582.155	754.681	611.382	414.416	453.969	774.311
Note:						*p<0.05; **p<0.01; ***p<.001

ANALYSIS OF PREDICTIVE BIAS

Analysis of predictive bias by race/ethnicity and gender are not presented in this report because of the small sample sizes.

RACE/ETHNICITY

As shown in Table 26, the subgroups by race for the VPRAI-R fall under the 1,000 overall sample size and the 200 subgroup sample size threshold established for this report, and therefore analyses will not be shown.

Table 26. Distribution of Assessments by VPRAI-R Risk Category

VPRAIR Risk Score	White	Black	Hispanic
1	22	17	81
2	32	37	36
3	27	39	61
4	44	40	55
5	31	29	34
6	16	12	20

GENDER

As shown in Table 27, the subgroups by gender for the VPRAI-R fall under the 1,000 overall sample size and the 200 subgroup sample size threshold established for this report, and therefore analyses will not be shown.

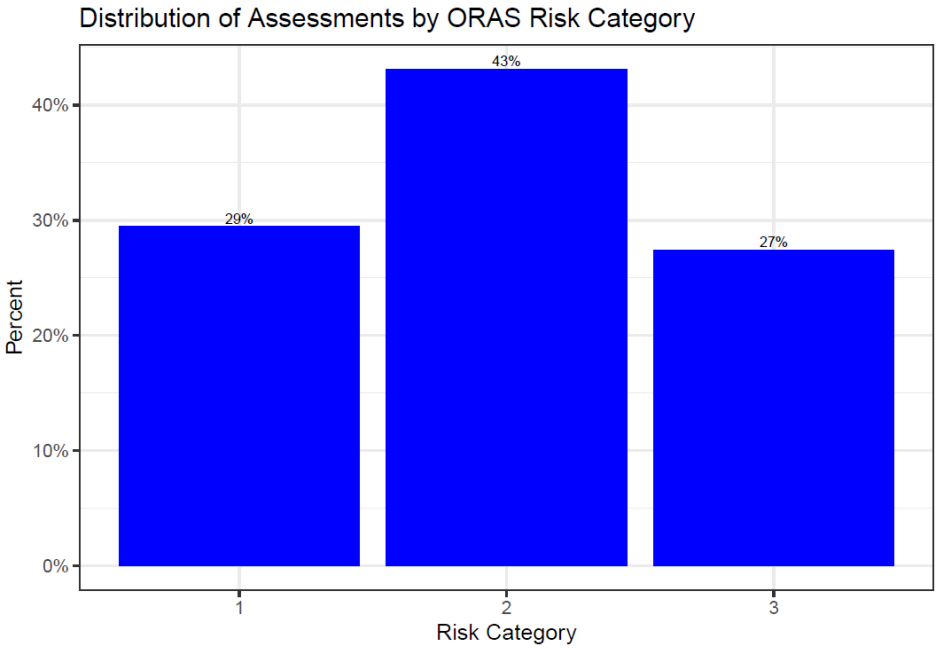
Table 27. Distribution of Assessments by VPRAI-R Risk Category

VPRAIR Risk Score	Male	Female
1	101	38
2	105	13
3	129	13
4	129	14
5	92	12
6	40	9

ORAS VALIDATION

GENERAL VALIDATION

The following chart shows the distribution of risk categories for individuals in the evaluation data set assessed with the ORAS tool, used by the Pretrial Pilot Projects in Modoc, Napa, Nevada, Ventura, and Yuba Counties. The ORAS tool developer divided the risk scores into three risk levels: level 1 includes scores 0–2; level 2, scores 3–5; and level 3, scores 6–9.[31] Risk level 2 (scores 3–5) was the most commonly assessed risk level in the evaluation data set, followed by level 1 (scores 0–2) and level 3 (scores 6–9). The distribution of all assessed individuals may differ from the distribution in the evaluation data set because the evaluation data set includes only released individuals with concluded pretrial periods.



ORAS Risk Level	Total
1	235
2	344
3	219

Table 28 shows the AUC value for the ORAS tool, using the three established risk levels for each outcome of interest. The AUC value is a single number that represents the ability of the tool to discriminate between individuals who are lower or higher risk across the range of the tool. For criminal

[31] Edward J. Latessa, Richard Lemke, Matthew Makarios, Paul Smith, and Christopher T. Lowenkamp, "The Creation and Validation of the Ohio Risk Assessment System (ORAS)" (2010) 74(1) *Fed. Probation* 16.

justice risk assessments, a common metric for evaluating AUC values is derived from Demarais and Singh (2013),[32] who defined AUC values less than 0.55 as poor, 0.55–0.63 as fair, 0.64–0.70 as good, and 0.71–1.00 as excellent. By these definitions, the AUC values for the ORAS are excellent for new filing; good for new arrest, new conviction, and FTA or new arrest; and fair for FTA and for new violent arrest.

The 95% confidence interval is also shown. It represents the range of AUC estimates that the true AUC value is 95% likely to fall between. A smaller range indicates that given the size of the sample and pattern of the data, the AUC can be estimated with greater precision. None of the 95% confidence intervals fall below the fair range.

Table 28. AUC values for the ORAS, by Adverse Outcome

Outcome	AUC	CI (95%)
FTA	0.630	0.587-0.674
New Arrest	0.707	0.673-0.742
New Filing	0.720	0.673-0.766
New Conviction	0.698	0.647-0.749
New Violent Arrest	0.615	0.556-0.674
FTA or New Arrest	0.695	0.661-0.73

[a] N = 798

The following series of charts shows the rate of various adverse outcomes during the pretrial period at each risk level of the ORAS.[33] For each outcome of interest,[34] observed rates of the outcome increase consistently as the assessed risk level increases. The ORAS tool was specifically designed to predict a combination of risk of failure to appear in court and risk of a new arrest.

[32] Desmarais, *Risk Assessment Instruments*.

[33] Risk levels are groupings of scores as defined by the tool developer.

[34] See the validation methodology section for definitions of each outcome of interest.

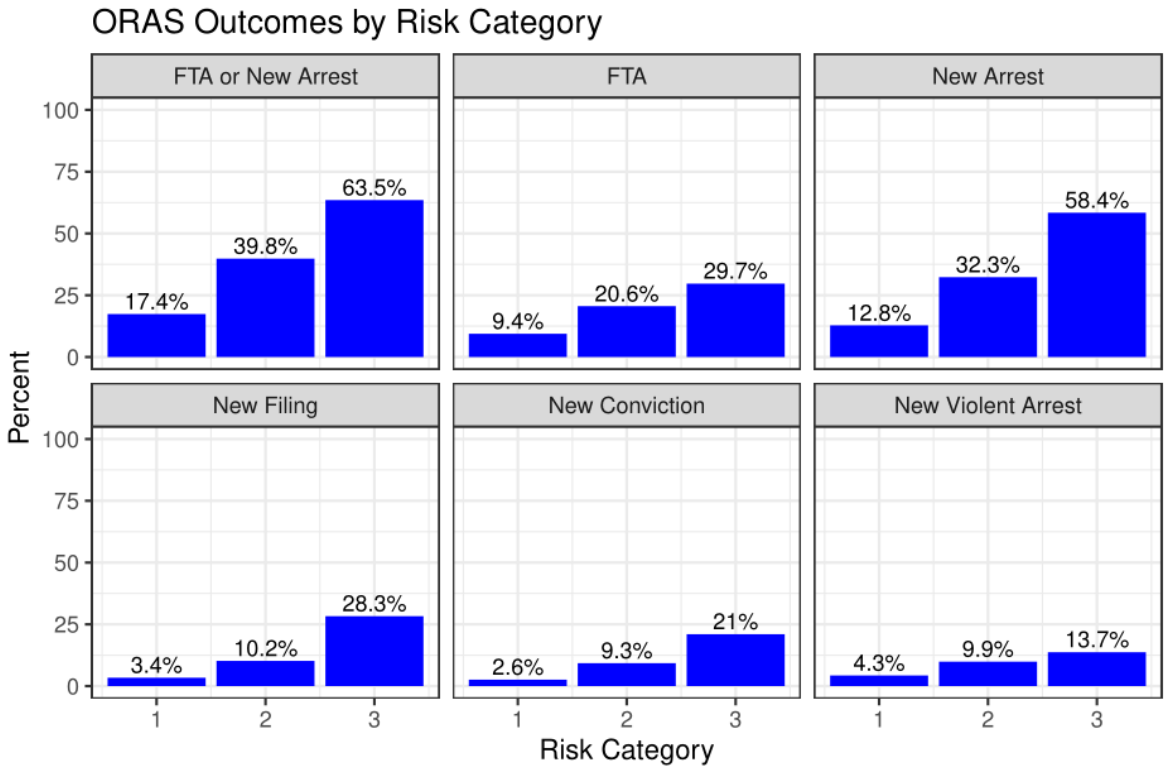


Table 29 shows the results from logistic regression models predicting each outcome of interest. The models control for the number of days the defendant spent released during the pretrial period. For each outcome of interest, the models show that the association between the ORAS risk score and the likelihood of that outcome during the pretrial period is statistically significant (p<0.001).

Table 29. Logistic Regression Models Testing the Probability of an Adverse Outcome Based on Risk Score and Days Released

	Dependent variable:					
	FTA	New Arrest	New Filing	New Conviction	New Violent Arrest	FTA or New Arrest
	(1)	(2)	(3)	(4)	(5)	(6)
ORAS Risk Score	0.656***	1.207***	1.249***	1.100***	0.564***	1.092***
	(0.126)	(0.123)	(0.173)	(0.184)	(0.171)	(0.114)
Days Released	0.003***	0.007***	0.005***	0.006***	0.004***	0.006***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Constant	−3.196***	−4.090***	−5.413***	−5.433***	−4.059***	−3.380***
	(0.316)	(0.322)	(0.478)	(0.510)	(0.437)	(0.286)
Observations	798	798	798	798	798	798
Log Likelihood	−374.484	−416.724	−264.263	−231.527	−232.662	−454.644
Akaike Inf. Crit.	754.969	839.448	534.527	469.054	471.323	915.288
Note:						*p<0.05; **p<0.01; ***p<.001

ANALYSIS OF PREDICTIVE BIAS

Analysis of predictive bias by race/ethnicity and gender are not presented in this report because of small sample sizes.

RACE/ETHNICITY

As shown in Table 30, the subgroups by race for the ORAS fall under the 1,000 overall sample size and the 200 subgroup sample size threshold established for this report, and therefore analyses will not be shown.

Table 30. Distribution of Assessments by ORAS Risk Category

ORAS Risk Score	White	Black	Hispanic
1	78	14	134
2	110	28	195
3	95	2	120

GENDER

As shown in Table 31, the subgroups by gender for the ORAS fall under the 1,000 overall sample size and the 200 subgroup sample size threshold established for this report, and therefore analyses will not be shown.

Table 31. Distribution of Assessments by ORAS Risk Category

ORAS Risk Score	Male	Female
1	179	56
2	261	83
3	174	45

VPRAI-O VALIDATION

The sample size for the VPRAI-O was smaller than the designated minimum sample size of 200 for general validation, and therefore it was not possible to validate the VPRAI-O risk assessment tool in the current validation study.

APPENDIX A. PSA VIOLENT OFFENSE LIST

PC CODE	DESCRIPTION
69	Obstructing or resisting exec officer in performance of duty; threats, force, or violence
136.1(c)(1)	Intimatidating/Threat Witness/Victim and Act is accompanied by force
140(a)	Threatening Witnesses, victims or informants.
148(b)	Removal or taking of weapon other than firearm from peace officer during commission of resisting offense
148(c)	Removal or taking of firearm from peace officer during commission of resisting offense
148(d)	Removal or taking of weapon firearm from peace officer engaged in performance of duty
148.10(a)	Resist Po: Cause death/SBI
149	Assault by a public officer
151	Advocacy to kill or injure peace officer
186.26(c)	Use of coercion or violence to solicit or recruit another to actively participate in criminal street gang
187(a)	Murder first or second degree
191.5(a)	Gross vehicular manslaughter while intoxicated
192(a)	Voluntary manslaughter
192(b)	Involuntary manslaughter
192(c)(1)	Vehicular manslaughter with gross negligence
192(c)(3)	Vehicular manslaughter
192.5(a)	Vehicular manslaughter in the operation of a vessel while intoxicated
192.5(b)	Vehicular manslaughter in the operation of a vessel while intoxicated
192.5(c)	Vehicular manslaughter in the operation of a vessel
203	Mayhem
205	Aggravated Mayhem
206	Torture
207(a)	Kidnapping
207(b)	Kidnap -14 to com l&l
207(c)	Kidnapping by false pretense
207(d)	Kidnapping from outside the state
208(b)	Kidnap child under 14 yrs
209(a)	Kidnapping for ransom
209(b)(1)	Kidnap: commit rob/rape/etc
209.5(a)	Kidnap during carjacking
210.5	False imprisonment of a hostage
667.85	Kidnap to deprive parent
211	Robbery: first or second degree
212	Fear defined for robbery
212.5	Robbery; degrees
214	Train robbery
215	Carjacking
217.1(a)	Assault on a public official
217.1(b)	Attempted murder of a public official
218	Train wrecking; attempt; punishment.
218.1	Obstructing railroad track; punishment.
219	Train derailing or wrecking; punishment.
219.1	Throwing missile at common carrier with bodily harm

219.2	Throwing hard substance or shooting missile at train or other conveyance
220	Assault with intent to commit mayhem, rape, sodomy, oral copulation, or any violation of Section 264.1, 288, or 289
220(a)(1)	Assault with intent to commit a felony
220(a)(2)	Assault with intent to commit a felony-victim under 18
220(b)	Assault to commit a felony during the commission of a first degree burglary
222	Administering to another any chloroform, ether, laudanum, or any controlled substance, anesthetic, or intoxicating agent
236	False imprisonment
236.1	Human trafficking; provisions regarding minors; consideration of total circumstances
237(a)	False imprisonment
240	Assault
241	Assault
241.1	Assault on custodial officer
241.2	Assault on school or park property
241.3	Assault against person on public transportation, both on property of and within motor vehicle of provider
241.4	Assault on peace officer of a school district
241.5	Assault on a highway worker
241.6	Battery on school employee
241.7	Assault against jurors
241.8(a)	Battery against member of us armed forces
242	Battery
243	Battery
243.1	Battery on custodial officer
243.2(a)(1)	Battery on pers on school/park/grnds
243.25	Battery on an elder or dependent adult
243.3	Battery on transportation personnel/passenger
243.35	Battery on public transportation provider
243.4	Sexual battery
243.5(a)(1)	Assault or battery on school prop
243.6	Battery on school employee
243.65(a)	Battery against a highway worker
243.7	Battery against jurors
243.8(a)	Battery against a sports official
243.9(a)	Aggravated battery by gassing on peace officer or local detention facility employee
244	Aslt w/caustic chem/etc
244.5(b)	Assault with stun gun/taser
244.5(c)	Assault with stun gun or taser on peace officer or firefighter
245(a)(1)	Force/adw-not firearm: gbi
245(a)(2)	Aslt w/ firearm on person
245(a)(3)	Aslt w/machinegun on person
245(a)(4)	Force/adw not firearm: gbi
245(b)	Assault w/semiauto rifle
245(c)	Adw not f/arm: po/fire: gbi
245(d)(1)	Assault with a firearm upon a peace officer or firefighter
245(d)(2)	Assault on peaceofficer/firefighter with semiautomatic firearm
245(d)(3)	Machine gun/assault weapon on a peace officer/firefighter
245.2	Assault (adw/gbi) upon transportation personnel, mass transit personnel
245.3	Assault (adw/gbi) upon a custodial officer

245.5(a)	Adw/gbi schl emp: no f/arm
245.5(b)	Assault with firearm on a school employee
245.5(c)	Adw/stun gun or taser: school employee
245.6	Hazing resulting in death/serious bodily injury
246	Shoot: inhab dwell/veh/etc
246.3(a)	Firearm disch w/neg
246.3(b)	BB device disch w/ neg
261(a)	Rape
261.5(a)	Sex intercourse w/mnr -18
261.5(b)	Sex w/minor: + or - 3 yrs
261.5(c)	Sex w/minor:3+ yrs younger
261.5(d)	Sex w/minor: perp 21+ vic-16
262(a)(1)	Rape spouse by force/etc
262(a)(2)	Rape spouse und c/sub/etc
262(a)(3)	Rape: spouse uncon of act
262(a)(4)	Rape: spouse - threat to kidnap, inflict extreme pain, serious bodily injury
262(a)(5)	Rape: spouse - threat to incarcerate, arrest, deport
262(a)(6)	Rape of spouse by threat to arrest or deport
264.1	Rape/etc: cncrt force/viol
266a	Taking a person for prostitution
266b	Abduction to live in illicit relation; using force
266c	Unlawful sexual intercourse, sexual penetration, oral copulation, or sodomy; consent procured by false or fraudulent representation with intent to create fear
266h(b)	Pimping a minor
266i(b)	Pandering a minor
266j	Procurement of child under age 16 for lewd and lascivious acts
267	Abduction; person under 18 for purpose of prostitution
269(a)	Agg sex aslt: mnr: frce/etc
273.4	Female genital mutilation
273.5(a)	Injuring a spouse, cohabitant, fiancé, boyfriend, girlfriend or child's parent
273.5(f)	Inf crpl inj: sps/etc w/pr
273.6(b)	Viol crt ord to prev domes viol – results in physical injury
273.6(d)	Domestic violence w/prior – act of violence or a credible threat of violence
273a(a)	Willful cruel to child/poss inj/death
273a(b)	Willful cruelty to child
273ab(a)	Assault of child under 8 by force likely to produce GBI resulting in death
273ab(b)	Assault of child under 8 by force likely to produce GBI resulting in brain injury, paralysis
273d(a)	Inflict injury upon child
278	Child stealing
285	Incest
286(b)	Sodomy: person under 18
286(c)	Sodomy: person under 14
286(d)	Sodomy in concert w/force
286(f)	Sodomy: vict uncons of act
286(g)	Sodomy: vict incapbl:consent
286(h)	Sodomy: vic/def in mntl inst
286(i)	Sodomy: no ok: vict drugged
286(j)	Sodomy by impersonation
286(k)	Sodomy under color of authority
288(a)	Lewd or lasciv acts/w/child und 14yrs

288(b)	Lewd/lasc acts w/child under 14 or dependent person
288(c)	Lewd/lasc act w/chld 14/15:def 10yr+ or dependent person
288.2(a)	Harmful mtr sent w/int of seduc minor
288.3	Contact with intent to commit sex act
288.4	Arranging a meeting with minor for lewd purposes
288.5(a)	Continuous sexual abuse of child
288.7(a)	Sex/sodomy with a child under 10
288.7(b)	Oral copulation/sexual penetration with a child under 10
287(b)	Oral copulation w/pers und 18yrs
287(c)	Oral copul w/person und 14/by force
287(d)	Oral cop in concert: vic incap of con
287(f)	Oral cop: vic uncon/asleep
287(g)	Oral copulation of an incompetent person
287(h)	Oral cop: vic/def in mntl inst
287(i)	Oral copulation by anesthesia or controlled substance
287(j)	Oral copulation by impersonation
287(k)	Oral copulation under color of authority
288a(b)	Oral copulation w/pers und 18yrs
288a(c)	Oral copul w/person und 14/by force
288a(d)	Oral cop in concert: vic incap of con
288a(f)	Oral cop: vic uncon/asleep
288a(g)	Oral copulation of an incompetent person
288a(h)	Oral cop: vic/def in mntl inst
288a(i)	Oral copulation by anesthesia or controlled substance
288a(j)	Oral copulation by impersonation
288a(k)	Oral copulation under color of authority
289	Sexual pen with force/etc
289.6(a)(3)	Sex: emp/etc cnf/detention fac
311.4(a)	Using Minors for Sex Acts
311.4(b)	Using Minors for Commercial Sex Acts
311.4(c)	Using Minors for Sex Acts
347(a)	Poisoning, willful poison/etc food/etc
368(b)	Cause harm/death elder dep adult
368(c)	Elder/dependent adult cruelty
368(f)	False imprison: elder/dep adult violence
404(a)	Rioting
417(a)	Exhibit firearm or deadly weapon other than gun. Drawing, exhibiting, or using firearm or deadly weapon; self defense; peace officers.
417(b)	Exhibit firearm. Drawing, exhibiting, or using a firearm
417(c)	Exhibit firearm in presence of p.o. Drawing, exhibiting, or using firearm or deadly weapon; self defense; peace officers.
417.3	Exhibit firearm pres beh occupt
417.8	Exhibit firearm/etc: resist arrest
422.6(a)	Violate civil rights by force or threat
451(a)	Arson causing great bodily injury
451(b)	Arson: inhabited structure/property
451.1	Arson with added circumstances
451.5(a)	Aggravated arson
452(a)	Causing fire that causes gbi
452(b)	Causing fire of inhabited struc/prop
455	Arson attempts and acts preliminary or in furtherance
646.9(a)	Stalking

646.9(b)	Stalking/temp restraining order
647.6(a)(1)	Annoy/molest child under 18yrs
647.6(b)	Annoy/molest child/ill entry of bldg
647.6(c)	Annoy/etc child -18 w/prior
667.61(d)(2)	Felony sex offenses; victim kidnapped increasing risk of harm
667.61(d)(3)	Felony sex offenses; victim tortured
667.61(e)(1)	Felony sex offense; victim kidnapped
667.61(e)(2)	Felony sex offenses during commission of burglary
667.61(e)(4)	Felony sex offenses against more than one victim
667.61(e)(5)	Felony sex offenses -tying or binding of victim or another person
667.8	Kidnap to commit sex offense
667.85	Kidnap child under 14 yrs
674	Sex offense by daycare provider
836.6(c)	Escape from custody by force or violence
4500	Assault by a life prisoner
4501	Assault by a state prisoner
4501.1(a)	Aggravated battery
4501.5	Battery on non-confined person by prisoner
4503	Holding of hostages; offense
4530(a)	Escape from custody by force and violence
4532(a)(2)	Escape from alternative custody by force or violence by person booked on misdemeanor
4532(b)(2)	Escape from alternative custody by force or violence by person booked on felony
11413(a)	terrorism by explosion
11413(b)	terrorism by explosion (specified places)
11418(b)	weapons of mass destruction: use and damage to life
11418(c)	weapons of mass destruction: use and damage to public natural resources
11418(d)	weapons of mass destruction: creation of new pathogens
18740	Use of destructive device and explosive to injure/destroy
18745	Explosion with intent to murder
18750	Explosion of destructive device causing bodily injury
18755	Explosion causing death, mayhem, GBI
26100(c)	Discharge of firearm at another person from motor vehicle
18540(a)	Use of firearm to intimidate a voter
664/187(a)	Attempted murder?
664/211	Attempted robbery
Veh Code 2800.3(a)	SBI caused by flight from peace officer
Veh Code 2800.3(b)	Death caused by flight from peace officer
All attempts (PC 664), conspiracy (PC 182), solicitation (PC 653f), and accessory (PC 31) only if before the act of any of the offenses identified here also meet the definition of a violent offense for purposes of administering the PSA.	

APPENDIX B.

Date range for indiv counties

County	Tool	Earliest Assessment Date	Latest Assessment Date
Alameda	VPRAIR	2020-05-12	2020-12-30
Calaveras	PSA	2019-10-12	2020-10-05
Kings	VPRAIO	2020-03-16	2020-10-28
Los Angeles	PSA	2020-03-23	2020-12-31
Modoc	ORAS	2020-07-12	2020-11-03
Napa	ORAS	2020-04-02	2020-12-03
Nevada	ORAS	2020-05-27	2020-10-19
Sacramento	PSA	2019-10-22	2020-10-24
San Joaquin	VPRAI	2016-11-08	2020-12-31
San Mateo	VPRAIR	2020-04-28	2020-12-30
Santa Barbara	VPRAI	2020-01-01	2020-04-28
Santa Barbara	VPRAIR	2020-04-29	2021-01-05
Sonoma	PSA	2020-07-01	2020-12-30
Tuolumne	PSA	2020-06-30	2020-09-25
Ventura	ORAS	2019-10-03	2020-12-31
Yuba	ORAS	2020-01-02	2020-12-22