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Predicting Recidivism of Offenders Released from the West Virginia Division of Corrections: Validation of the Level of Service/Case Management Inventory

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Risk and need assessments are an integral component of evidence-based treatment and effective management of offenders throughout their supervision. Assessment instruments enable agencies and correctional professionals to individualize treatment interventions, efficiently utilize limited resources, and enhance public safety. The Level of Service/Case Management Inventory (LS/CMI) is an actuarial risk assessment system which is designed to identify an offender's risk, needs, and responsivity factors in order to inform treatment and supervision decisions. Correctional programs can substantially reduce recidivism rates by using assessments to focus treatment on higher risk offenders, target interventions to address offenders' criminogenic needs, and incorporate individual responsivity factors into case planning and service delivery.

In West Virginia, the LS/CMI was adopted by adult community corrections programs in 2006 and in the Division of Juvenile Services in 2008. Implementation was then expanded under the statewide initiative in 2009, and the LS/CMI was introduced in the WV Division of Corrections (DOC) in 2011. Presently, all DOC inmates are given an LS/CMI assessment upon entry to a facility, and are reassessed on an annual basis or when an inmate's circumstances have changed in a manner which warrants reassessment. Prior to release, the results of the LS/CMI are used to guide reentry case plans and parole decisions. In 2013, the implementation of the Justice Reinvestment Initiative (JRI) in West Virginia (Senate Bill 371) expanded the use

Report Highlights...

This study examines whether the LS/CMI risk assessment tool effectively predicts recidivism for offenders released from the supervision of the West Virginia Division of Corrections.

Utilization of the LS/CMI and adherence to the risk, need, and responsivity (RNR) principles can facilitate substantial reductions in recidivism.

Findings indicate that the LS/CMI total risk score is a significant predictor of recidivism when controlling for confounding variables. Specifically, total risk scores are predictive of future jail bookings and reincarceration.

Recidivism rates for WV DOC offenders increase as LS/CMI risk levels increase.

Significant correlations exist between LS/CMI total score and all three recidivism measures: *jail booking*, *reincarceration*, and *any recidivism*.

Subanalyses indicate that the LS/CMI is an accurate predictor of recidivism for violent offenders.

of the LS/CMI to the courts and probation supervision.

Recent studies show that the LS/CMI accurately predicts recidivism and other post-release outcomes for day report center clients in West Virginia. Specifically, researchers have found that LS/CMI risk scores are powerful predictors of client success in day report centers, with lower scores

corresponding to a higher probability of successful program completion (Spence & Haas, 2014). Additionally, research has shown that the LS/CMI is an effective predictor of many recidivism outcomes for clients of West Virginia day report centers, including new arrests, jail bookings, and incarcerations (Spence & Haas, forthcoming). However, further research is necessary to confirm the tool's utility for West Virginia's Division of Corrections population. The present study addresses this need by analyzing the predictive validity of the LS/CMI for offenders under DOC supervision in West Virginia. Specifically, the report investigates whether DOC offenders' recidivism rates increase in accordance with their LS/CMI risk levels, and also examines the predictive validity of the tool for females and violent offenders using various subanalyses. The question of whether particular subcomponents predict recidivism more effectively than others is also explored.

About the LS/CMI Section 1 subcomponents...

Criminal History identifies the frequency and gravity of past and present offenses, occurrences of institutional misconduct, and age of initial contact with the criminal justice system.

Education/Employment explores offenders' experiences and participation in the labor market and formal educational institutions.

Family/Marital considers the quality of offenders' family and marital relationships to identify the presence of prosocial support persons or criminal influences.

Leisure/Recreation examines participation in prosocial, organized activities and constructive use of leisure time.

Companions recognizes the number and proximity of criminal acquaintances and friends as well as prosocial associates.

Alcohol/Drug Problem assesses past and present substance abuse issues along with related resultant problems.

Procriminal Attitude/Orientation investigates offenders' general views regarding law violation, conventional society, the criminal justice system, and their individual sentences and treatment.

Antisocial Pattern encompasses a variety of items in order to identify an overarching pattern of problematic behavior.

The Predictive Validity of the LS/CMI

The level of service scales are the most widely used risk assessment instruments worldwide (Olver, Stockdale, & Wormith, 2013). Their predictive validity has been established by several meta-analyses which have demonstrated that these scales are effective predictors of recidivism (Olver et al., 2013; Vose, Cullen, & Smith, 2008). The LS/CMI, which is the most recent version of the level of service scales, has also been shown to predict recidivism regardless of an offender's demographic characteristics such as gender (Olver et al., 2013; Rettinger & Andrews, 2010), ethnicity, and age (Olver et al., 2013). Furthermore, the predictive validity of the instrument has been recorded with regard to specific offender groups such as gang members (Guay, 2012) and sex offenders (Wormith, Hogg, & Guzzo, 2012).

The first section of the LS/CMI, from which an offender's total risk score is derived, contains eight subsections which explore various individual characteristics and circumstances predictive of future recidivism. These subcomponents correspond to the "Central 8" risk and need areas: Criminal History, Education/Employment, Family/Marital, Leisure/Recreation, Companions, Alcohol/Drug Problem, Procriminal Attitude/Orientation, and Antisocial Pattern. Research has established a relationship between these domains and the likelihood of recidivism (Andrews & Bonta, 2010). Scores range from 0 to 43 and indicate a risk

level of Very Low (0 - 4), Low (5 - 10), Medium (11 - 19), High (20 - 29), or Very High (30 - 43). The LS/CMI contains ten additional unscored sections which identify specific responsivity issues, document prison experience, facilitate effective case planning, and enable staff to monitor clients' progress. The LS/CMI is considered a fourth-generation assessment tool because it builds on previous generations of risk assessment instruments to include a case management component and responsivity considerations. This assists staff in formulating treatment and case management plans based on an offender's highest criminogenic needs.

DATA AND METHODS

Population and Sample

Currently, the West Virginia Division of Corrections includes 13 correctional facilities, 4 work release centers, and 15 parole offices throughout the state. This study's sample was derived from a cohort of male and female offenders who were assessed using the LS/CMI and were released from DOC custody. The total number of offenders released during the studied time period was 3,384. LS/CMI assessment results were retrieved from the online database managed by the ORSP and used to identify the 1,288 offenders (38% of the cohort) who had received an assessment prior to release. The final sample consists of 1,288 offenders who were incarcerated in West Virginia DOC facilities, received an LS/CMI assessment, and were released between July 1, 2012, and June 30, 2013.

The demographic and legal characteristics of the offenders in the final sample are displayed in Table 1. The mean age is 32.9, with 76.7% of those in the sample falling between the ages of 20 and 39. The majority of offenders are white (88.8%) and male (88.4%), and 61.9% did not graduate from high school. Property offenses make up the largest proportion (44.4%) of the sample, followed by drug offenses (23.8%). Violent crimes (i.e., murder, sex offenses, robbery, and assault) total approximately 17% of the sample. Public order offenses are the least common, with 14.8% incarcerated for DUI and other charges.

Mean values for LS/CMI total scores and subcomponent scores are provided in Table 2. The mean LS/CMI total score for offenders in the study sample is

21.45 with a standard deviation of 6.83. The lowest score observed in the sample is 2 and the highest is 41. Scores for each subcomponent span the entire possible range.

Outcome Measures

Jail booking data and WV DOC commitment data from the date range of July 1, 2012, to June 30, 2014, were used to formulate three recidivism measures. *Jail booking* and *reincarceration* are dichotomous variables that are coded as "1" if an offender was booked into a regional jail or reincarcerated in a DOC facility, respectively, at any point during the follow-up period and "0" otherwise. *Any recidivism* is another dichotomous variable which is coded as "1" if an offender was either booked or incarcerated at any point during the follow-up period. These variables are standardized to ensure a uniform follow-up period of 12 months for each offender in the sample.

Analysis Plan

The analyses unfold in several stages. First, we examine the rates of recidivism for offenders by risk level using

Report Highlights...

This study employs a sample of 1,288 offenders under WV DOC supervision who received an LS/CMI assessment and were released between July 2012 and June 2013.

Most offenders in the sample are white males between the ages of 20 and 39.

Property crimes are the most common among the offenders in the sample, followed by drug offenses.

Three dichotomous recidivism measures were formulated using regional jail booking data and DOC commitment data.

Recidivism is measured as any regional jail booking or commitment to DOC within the follow-up period of 12 months.

Table 1
Demographic and Legal Characteristics of Sample (N = 1,288)

	N	%		N	%
Age (mean = 32.9, SD = 10.1)			Race		
Under 20	16	1.2	White	1144	88.8
20-29	548	42.5	Black	131	10.2
30-39	441	34.2	Multi-Racial or Other	7	0.5
40-49	172	13.4	Hispanic or Latino	4	0.3
50 and over	111	8.6	Asian	1	0.1
Total	1,288	99.9	Unknown	1	0.1
			Total	1,288	100.0
Education Level			Gender		
Did Not Graduate H.S.	797	61.9	Male	1,138	88.4
H.S. Diploma	354	27.5	Female	150	11.6
Post H.S. Education	83	6.4	Total	1,288	100.0
Unknown	54	4.2			
Total	1,288	100.0			
Offense (Type)					
Murder	20	1.6			
Sex Offenses	57	4.4			
Robbery	71	5.5			
Assault	70	5.4			
Burglary	250	19.4			
Property	322	25.0			
Drug Offenses	307	23.8			
DUI	52	4.0			
Other	139	10.8			
Total	1,288	99.9			

Note: Percentages may not total 100.0% due to rounding.

chi-square analyses. Second, we investigate the bivariate relationships between recidivism and offenders' LS/CMI total scores and subsection scores by calculating correlation coefficients and conducting area-under-the-curve (AUC) analyses. AUC analyses are considered a more useful test of predictive validity than bivariate correlations when dealing with dichotomous dependent variables because AUC statistics are not as sensitive to base rates (Andrews

& Bonta, 2010; Rice & Harris, 2005). Third, we conduct multivariate logistic regression analyses in order to test the predictive ability of the LS/CMI while controlling for the confounding effects of other variables that are likely to impact recidivism. Finally, we examine the predictive validity of the tool for different subpopulations of offenders using a variety of methods, including independent samples t-tests, bivariate correlations, and AUC analyses.

Table 2**Descriptive Statistics and Possible Ranges for LS/CMI Total Score and Subcomponent Scores (N = 1,288)**

	Mean	Standard Deviation	Possible Score Range
LS/CMI Total Score	21.45	6.83	0 - 43
Criminal History	4.46	1.80	0 - 8
Education/Employment	4.66	2.64	0 - 9
Family/Marital	1.30	1.15	0 - 4
Leisure/Recreation	1.54	0.76	0 - 2
Companions	3.01	1.17	0 - 4
Alcohol/Drug Problem	4.03	2.13	0 - 8
Procriminal Attitude	1.17	1.46	0 - 4
Antisocial Pattern	1.29	1.07	0 - 4

Report Highlights...

The average LS/CMI total risk score for offenders in the sample is 21.45, which is considered a high level of risk.

Mean scores for Companions fall into the high risk category. All other subcomponents' mean scores indicate medium risk, except for Family/Marital, Procriminal Attitude/Orientation, and Antisocial Pattern, which are in the low range.

Sixty-one percent (61.1%) of offenders in the sample were assessed as having a high or very high level of risk, 33.4% had a medium risk level, and 5.5% had a low or very low risk level.

Results show that among offenders released from DOC, recidivism rates increase in accordance with LS/CMI risk levels.

Approximately 29% of low risk offenders recidivated within the follow-up period, compared to almost 51% of those assessed as very high risk.

RESULTS*Recidivism Rates by LS/CMI Risk Level*

As shown in Table 3 and Figure 1, results indicate that recidivism rates increase as clients' LS/CMI risk levels increase. For the outcome measures of *jail booking*, *reincarceration*, and *any recidivism*, recidivism rates increase in a stepwise fashion from low to very high.¹ As recorded by the *any recidivism* measure, 28.8% of offenders who were assessed as low risk recidivated, followed by approximately 33% for those in the medium range. A recidivism rate of 44.5% is observed for high risk offenders, while those who scored in the very high range recidivated at a rate of 50.6%.

Regional jail booking data indicate that of the offenders assessed as low risk, 28.8% were booked into a regional jail during the follow-up period, as were 32.6% of medium risk offenders. The jail booking measure also reveals that 42.4% of high risk offenders recidivated, while almost half of those who scored in the very high range were booked into a regional jail within one year of release from prison. Similarly, DOC commitment data show that only 6.1% of the offenders who scored in the low range were reincarcerated during the follow-up period. The reincarceration rate for medium risk offenders is approximately 9%, while this figure is almost 18% for high risk offenders. Of inmates who obtained an LS/CMI total

Table 3**Recidivism Rates of WV DOC Offenders by LS/CMI Risk Level (N = 1,288)**

LS/CMI Risk Level	Very Low (N = 5)	Low (N = 66)	Medium (N = 430)	High (N = 629)	Very High (N = 158)	Total (N = 1,288)
Jail Booking	2 (40.0%)	19 (28.8%)	140 (32.6%)	267 (42.4%)	78 (49.4%)	506 (39.3%)
Reincarceration	1 (20.0%)	4 (6.1%)	38 (8.8%)	112 (17.8%)	32 (20.3%)	187 (14.5%)
Any Recidivism	2 (40.0%)	19 (28.8%)	141 (32.8%)	280 (44.5%)	80 (50.6%)	522 (40.5%)

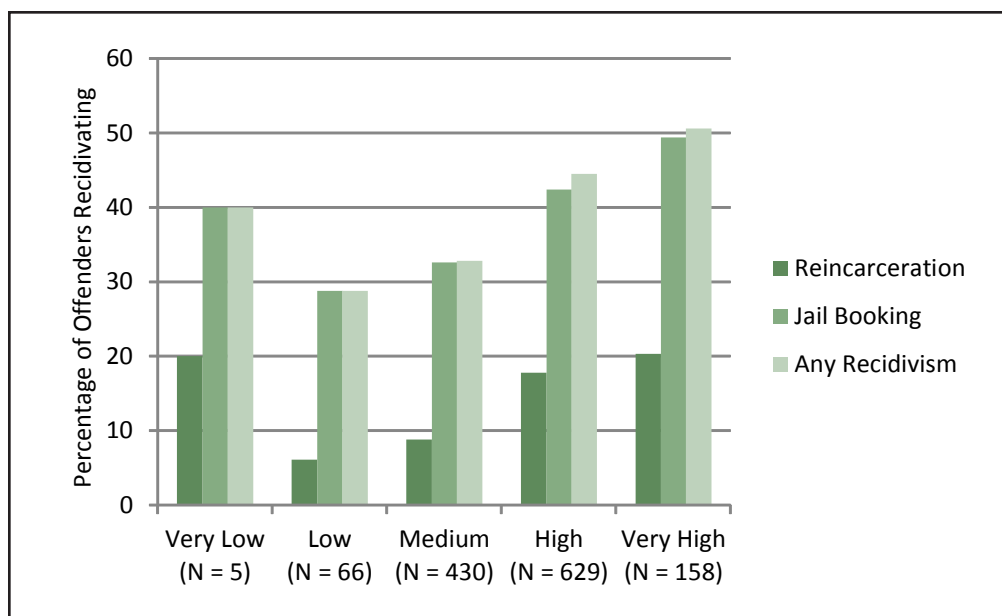
score in the very high range, 20.3% were reincarcerated within the 12 months following their release. Chi-square analyses indicate that these differences in recidivism rates between risk levels are statistically significant ($p < 0.001$).

Bivariate Analyses of the Relationships between LS/CMI Scores and Recidivism

Table 4 presents bivariate correlations between the recidivism measures and LS/CMI total and subcomponent scores. Results indicate that LS/CMI total risk score is positively and significantly correlated with *jail booking*, *reincarceration*, and *any recidivism*. Overall, the strongest bivariate relationships are found between LS/CMI total score and each recidivism measure. The correlation between total risk score and *jail booking* is 0.127, while

this figure is 0.137 for *reincarceration*. A correlation of 0.143 is found between total score and *any recidivism*. These findings indicate a positive relationship between LS/CMI total risk scores and the likelihood of recidivism.

Furthermore, six of the eight LS/CMI subcomponents are significantly correlated with all three recidivism measures. The subcomponents that have the greatest correlations with recidivism are Education/Employment, Companions, and Antisocial Pattern. The correlation between Education/Employment and *any recidivism* is 0.123, demonstrating that a higher risk score in this category is associated with a greater probability of recidivism. Similarly, the correlation between Antisocial Pattern and *any recidivism* is 0.112, while the variables of Companions and *any recidivism* have a correlation of 0.110. For the

Figure 1**Recidivism Rates of WV DOC Offenders by LS/CMI Risk Level (N = 1,288)**

measure of *jail booking*, the subcomponents that have the strongest relationship with recidivism are Education/Employment ($r = 0.111$) and Antisocial Pattern ($r = 0.100$). With regard to *reincarceration*, Companions ($r = 0.125$) is the subcomponent with the largest correlation, followed by Antisocial Pattern ($r = 0.111$). Overall, results indicate a positive and statistically significant relationship between most subcomponent scores and the likelihood of recidivism.

Two LS/CMI subcomponents—Procriminal Attitude/Orientation and Family/Marital—are not significantly correlated with any of the recidivism measures. This is surprising, particularly with regard to Procriminal Attitude, given that this domain is widely considered to be one of the most powerful predictors of recidivism. These findings suggest that additional attention should be focused on assessing the Procriminal Attitude and Family/Marital subcomponents, with an emphasis on enhanced training and supplemental scoring strategies for staff.

The results of area-under-the-curve (AUC) analyses are depicted in Table 5. The AUC statistic for *any recidivism* is 0.589, denoting that an offender’s LS/CMI total score accurately predicts recidivism in approximately 58.9% of cases. This figure is higher for *reincarceration* (AUC = 0.616) which indicates that the total score accurately predicts reincarceration outcomes for almost 61.6% of offenders.

For *jail booking*, this statistic is 0.579, which reveals that an LS/CMI total score correctly predicts bookings 57.9% of the time. The AUC values for the models that contain only subcomponent scores are lower than those for the models which contain LS/CMI total scores, with test statistics ranging from 0.505 to 0.595. Consistent with the findings in Table 4, the domains with the lowest AUC statistics are Procriminal Attitude/Orientation and Family/Marital.

Multivariate Analyses of the Relationship between LS/CMI Scores and Recidivism

Multivariate logistic regression models were estimated in order to test the impact of various factors—LS/CMI total score, age, years of education, race, gender, and length of stay—on the likelihood of recidivism. The results of three regression models are displayed in Table 6. Findings related to the first model demonstrate that, when controlling for the confounding effects of other variables, LS/CMI total score and age are statistically significant predictors of the likelihood that an offender will subsequently be booked into a regional jail. The positive regression coefficient and odds ratio of 1.026 for LS/CMI total score indicate that for every 1-point increase in an offender’s total risk score, the odds of a future jail booking increase by 2.6% ($p < 0.01$). As expected, results

Table 4
Bivariate Correlations of LS/CMI Total Score and Subcomponent Scores with Jail Booking, Reincarceration, and Any Recidivism (N = 1,288)

	Jail Booking	Reincarceration	Any Recidivism
LS/CMI Total Score	0.127***	0.137***	0.143***
Criminal History	0.067*	0.066*	0.068*
Education/Employment	0.111***	0.089**	0.123***
Family/Marital	0.013	0.044	0.020
Leisure/Recreation	0.070*	0.057*	0.076**
Companions	0.098***	0.125***	0.110***
Alcohol/Drug Problem	0.063*	0.095**	0.081**
Procriminal Attitude	0.021	0.013	0.020
Antisocial Pattern	0.100***	0.111***	0.112***

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5

Area-Under-the-Curve (AUC) Statistics for LS/CMI Total Score and Subcomponent Scores for Jail Booking, Reincarceration, and Any Recidivism (N = 1,288)

	Jail Booking	Reincarceration	Any Recidivism
LS/CMI Total Score	0.579	0.616	0.589
Criminal History	0.538	0.549	0.538
Education/Employment	0.570	0.577	0.576
Family/Marital	0.505	0.528	0.509
Leisure/Recreation	0.538	0.541	0.542
Companions	0.557	0.595	0.564
Alcohol/Drug Problem	0.536	0.576	0.547
Procriminal Attitude	0.510	0.514	0.508
Antisocial Pattern	0.563	0.586	0.570

Note: All AUC statistics are derived from separate logistic regression models that contain only the LS/CMI total score or subcomponent score and the relevant recidivism measure.

Report Highlights...

LS/CMI total risk score is positively and significantly correlated with all three recidivism measures, indicating that higher LS/CMI scores are associated with a greater likelihood of jail bookings and reincarceration.

Multivariate logistic regression results indicate that when controlling for confounding variables, LS/CMI total risk score is a significant predictor of recidivism.

Each 1-point increase in LS/CMI total score increases the likelihood of a future jail booking by 2.6% and the odds of reincarceration by 5.1%.

Area-under-the-curve (AUC) analyses demonstrate that LS/CMI scores predict jail bookings in roughly 58% of cases, and reincarceration in approximately 62% of cases.

also show that an offender's age impacts the likelihood of recidivism. The negative coefficient and odds ratio of 0.957 for the age variable signify that for every year an offender's age increases, the odds of being booked into a regional jail decrease by approximately 4% ($p < 0.001$). The AUC statistic for this model is 0.639, which indicates that, collectively, the variables in the model accurately predict the likelihood of a jail booking in nearly 64% of cases.

The second model shows that LS/CMI total score, age, and length of stay are statistically significant predictors of reincarceration. The positive coefficient and odds ratio of 1.051 for LS/CMI total score show that for every 1-point increase in total score, the odds of reincarceration increase by 5.1% ($p < 0.001$). Regarding the age variable, the negative coefficient and odds ratio of 0.964 demonstrate that for every year an offender ages, the odds of reincarceration decrease by 4.3% ($p < 0.001$). Finally, the odds ratio for the length of stay variable reveals that the longer an individual is incarcerated, the greater the odds of reincarceration. Specifically, for each 1-month increase in a person's prison stay, the likelihood of reincarceration increases by 0.4% ($p < 0.05$). The AUC statistic for this model is 0.644, which signifies that it accurately predicts 64.4% of reincarceration outcomes.

Table 6**Logistic Regression Estimates for Predictive Factors Associated with Recidivism (N = 1,288)**

	Jail Booking		Reincarceration		Any Recidivism	
	B (SE)	Odds Ratio	B (SE)	Odds Ratio	B (SE)	Odds Ratio
LS/CMI Total Score	0.025** (0.009)	1.026	0.050*** (0.013)	1.051	0.030** (0.009)	1.030
Age	-0.044*** (0.007)	0.957	-0.037*** (0.010)	0.964	-0.046*** (0.007)	0.955
Years of Education	-0.055 (0.037)		-0.032 (0.051)		-0.058 (0.037)	
Nonwhite	-0.096 (0.196)		-0.287 (0.281)		-0.090 (0.196)	
Female	-0.309 (0.195)		-0.032 (0.262)		-0.272 (0.193)	
Length of Stay (months)	0.001 (0.001)		0.004* (0.002)	1.004	0.001 (0.001)	
N	1234		1234		1234	
Nagelkerke R-Square	0.076		0.059		0.086	
AUC	0.639		0.644		0.647	

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The results of the third model illustrate that LS/CMI total risk score and age are significant predictors of *any recidivism*. The odds ratio of 1.030 for LS/CMI total score indicates that for every 1-point increase in a person's total score, the odds of recidivating increase by 3% ($p < 0.01$). The negative coefficient for the age variable and the odds ratio of 0.955 show that for each year an offender ages, risk of recidivism decreases by 4.5% ($p < 0.001$). This model has an AUC statistic of 0.647, which signifies that it is able to correctly predict outcomes almost 65% of the time. It is notable that the LS/CMI total score is statistically significant in all three models.

Multivariate logistic regression models were

also constructed in order to identify which LS/CMI subcomponents are the best predictors of recidivism. Table 7 displays the results of three logistic regression models which contain all of the LS/CMI subcomponents as independent variables for each recidivism measure.

According to the results of the first model, when controlling for the effects of all other subcomponents, scores in Education/Employment and Companions have a statistically significant impact on the likelihood of recidivism as measured by *jail booking*. Specifically, in the Education/Employment domain, the positive regression coefficient and odds ratio of 1.068 signify that for every 1-point increase in an offender's risk score, the odds

Table 7**Logistic Regression Estimates for LS/CMI Subcomponents' Impact on Jail Booking, Reincarceration, and Any Recidivism (N = 1,288)**

	Jail Booking		Reincarceration		Any Recidivism	
	B (SE)	Odds Ratio	B (SE)	Odds Ratio	B (SE)	Odds Ratio
Criminal History	0.036 (0.037)		0.030 (0.052)		0.028 (0.037)	
Education/Employment	0.066* (0.026)	1.068	0.039 (0.036)		0.068** (0.026)	1.071
Family/Marital	-0.073 (0.055)		-0.026 (0.075)		-0.071 (0.055)	
Leisure/Recreation	0.024 (0.088)		-0.064 (0.128)		0.020 (0.088)	
Companions	0.117* (0.058)	1.124	0.278** (0.088)	1.320	0.132* (0.058)	1.142
Alcohol/Drug Problem	0.012 (0.030)		0.068 (0.042)		0.026 (0.030)	
Procriminal Attitude	-0.015 (0.049)		-0.073 (0.068)		-0.023 (0.049)	
Antisocial Pattern	0.090 (0.082)		0.168 (0.110)		0.110 (0.082)	
Nagelkerke R-square	0.031		0.049		0.038	
AUC	0.592		0.638		0.602	

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

of a jail booking increase by 6.8% ($p < 0.05$). Likewise, with each 1-unit increase in a person's risk score in the Companions category, the likelihood of a regional jail booking increases by 12.4% ($p < 0.05$). The AUC statistic for this model is 0.592, indicating the ability of the model to accurately predict jail bookings in 59.2% of cases.

The findings of the second model illustrate that the subcomponent of Companions has a statistically significant impact on the likelihood of reincarceration. The positive regression coefficient and odds ratio of 1.320 show that the odds of reincarceration increase by 32% ($p < 0.01$) with each 1-point increase in an offender's Companions score. The

AUC value of 0.638 indicates that this model can accurately predict approximately 64% of reincarceration outcomes.

The third model demonstrates that scores in Education/Employment and Companions have a statistically significant impact on the likelihood of *any recidivism*. A positive coefficient and odds ratio of 1.071 denote that for each additional risk point in the Education/Employment category, the odds of recidivism increase by 7.1% ($p < 0.01$). Similarly, recidivism is 14.2% ($p < 0.05$) more likely with each 1-unit increase in a person's Companions risk score. The AUC statistic for this model is 0.602, indicating that it accurately predicts recidivism outcomes for 60.2% of offenders.

Predictive Validity of the LS/CMI by Gender

Several subanalyses were conducted in order to assess whether the LS/CMI is an effective predictor of recidivism for both males and females. As displayed in Table 8, male and female offenders in the sample attained similar mean LS/CMI total risk scores as well as comparable mean values on most subcomponents. The mean total score for males is 21.36 while the mean total score for females is 22.11; however, this difference is *not* statistically significant. Some differences are apparent upon examination of the mean subcomponent scores. Specifically, males score

Report Highlights...

Male and female offenders in the sample have comparable mean LS/CMI total scores.

Males scored higher in the Criminal History and Companions subcomponents, while females were assessed as having higher needs in Education/Employment, Family/Marital, and Alcohol/Drug Problem.

Both males and females received low scores in the domains of Procriminal Attitude/Orientation and Antisocial Pattern.

significantly higher than females in the Criminal History and Companions subcomponents ($p < 0.01$), while female offenders' mean scores are significantly higher in the domains of Education/Employment ($p < 0.05$), Family/Marital, and Alcohol/Drug Problem ($p < 0.001$).

Figure 2 depicts a comparison of the percentages of male and female offenders assessed as medium risk or

Table 8

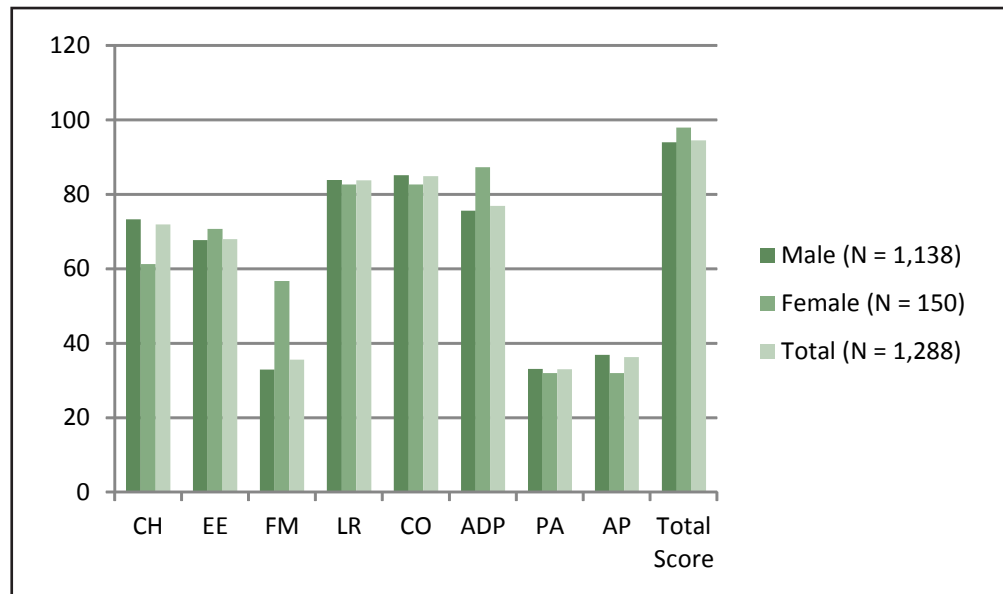
Comparison of LS/CMI Total Score and Subcomponent Mean Scores by Gender

	Male (N = 1,138) Mean (SD)	Female (N = 150) Mean (SD)	t	df
LS/CMI Total Score	21.36 (6.97)	22.11 (5.66)	-1.262	1286
Criminal History	4.51 (1.81)	4.04 (1.63)	3.055**	1286
Education/Employment	4.60 (2.63)	5.11 (2.63)	-2.251*	1286
Family/Marital	1.23 (1.11)	1.86 (1.28)	-6.455***	1286
Leisure/Recreation	1.54 (0.76)	1.50 (0.78)	0.641	1286
Companions	3.04 (1.18)	2.74 (1.11)	2.981**	1286
Alcohol/Drug Problem	3.95 (2.16)	4.61 (1.86)	-3.586***	1286
Procriminal Attitude	1.18 (1.48)	1.07 (1.31)	0.916	1286
Antisocial Pattern	1.30 (1.10)	1.18 (0.83)	1.336	1286

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Figure 2

Percentage of Offenders Medium Risk Level and Above on LS/CMI Total Score and Subcomponent Scores



higher based on LS/CMI total scores and subcomponent scores. Males and females have comparable results in most categories, with a high percentage scoring in the medium range and above in the areas of Leisure/Recreation, Companions, Education/Employment, and LS/CMI total score. Furthermore, a low percentage of both males and females score medium risk or higher in the domains of Procriminal Attitude and Antisocial Pattern. Notable differences are observed in three risk and need areas. In Family/Marital, a higher percentage (56.7%) of females than males (32.9%) score at least medium risk or higher. Similarly, a higher percentage (87.3%) of females are assessed as medium risk and above in the subcomponent of Alcohol/Drug Problem compared with males (75.6%). Conversely, a greater percentage (73.3%) of males are rated as medium and above than females (61.3%) in the area of Criminal History.

Table 9 displays percentages of recidivism by risk level with the sample separated by gender. For both male and female offenders, the same general trend is observed wherein recidivism rates generally increase as risk levels increase. However, the pattern is less consistent for females. About 33% of females identified as low risk were booked into a regional jail during the follow-up period, a recidivism rate that is higher than that of medium risk females and comparable to the recidivism rate for high risk females. Likewise, low risk females also have a reincarceration rate

of 33.3%, which is nearly twice that of the rate for high risk (17.2%) and very high risk females (15.4%). It is important to note, however, this finding should be viewed with caution due to the low number of females in this category (N = 3). Among females assessed as medium risk, 25.5% were booked into a regional jail during the year following their release. High risk females were booked in 39.1% of cases, and this figure is 46.2% for females assessed as very high risk. According to the *reincarceration* measure, of female offenders assessed as medium risk, 8.5% were reincarcerated, while 17.2% of those identified as high risk were committed to a DOC facility within a year after their release. A similar pattern is evident with the measure of *any recidivism*. Medium risk females recidivated at a rate of 25.5%, while 42.5% of high risk females recidivated, as did 46.2% of females assessed as very high risk.

Table 10 displays the bivariate correlations between LS/CMI total score and subcomponent scores with each of the recidivism measures for males and females. For the male subsample, LS/CMI total score is positively and significantly correlated with *jail booking*, *reincarceration*, and *any recidivism*. The largest correlation for this population is found between LS/CMI total score and *any recidivism* ($r = 0.145$). The subcomponents of Education/Employment, Companions, and Antisocial Pattern are also positively and significantly correlated with all three recidivism measures for males. Procriminal Attitude/Orientation is the only

Table 9**Recidivism Rates by LS/CMI Risk Level for Male and Female Offenders**

Males (N = 1,138)						
	Very Low (N = 5)	Low (N = 63)	Medium (N = 383)	High (N = 542)	Very High (N = 145)	Total (N = 1,138)
Jail Booking	2 (40.0%)	18 (28.6%)	128 (33.4%)	233 (43.0%)	72 (49.7%)	453 (39.8%)
Reincarceration	1 (20.0%)	3 (4.8%)	34 (8.9%)	97 (17.9%)	30 (20.7%)	165 (14.5%)
Any Recidivism	2 (40.0%)	18 (28.6%)	129 (33.7%)	243 (44.8%)	74 (51.0%)	466 (40.9%)
Females (N = 150)						
	Very Low (N = 0)	Low (N = 3)	Medium (N = 47)	High (N = 87)	Very High (N = 13)	Total (N = 150)
Jail Booking	0	1 (33.3%)	12 (25.5%)	34 (39.1%)	6 (46.2%)	53 (35.3%)
Reincarceration	0	1 (33.3%)	4 (8.5%)	15 (17.2%)	2 (15.4%)	22 (14.7%)
Any Recidivism	0	1 (33.3%)	12 (25.5%)	37 (42.5%)	6 (46.2%)	56 (37.3%)

domain for which significant correlations are not found for male offenders. For females, LS/CMI total risk score is not significantly correlated with any of the recidivism measures. Furthermore, only four correlations between LS/CMI subcomponents and recidivism are significant for females. The strongest correlation is found between Companions and *reincarceration* ($r = 0.251$). Criminal History is also significantly correlated with *reincarceration* for female offenders ($r = 0.164$). Additionally, the subcomponent of Alcohol/Drug Problem is significantly correlated with both *jail booking* and *any recidivism* for female offenders. These findings raise questions about the predictive utility of the LS/CMI for female offenders in West Virginia, but they may also reflect the limitations imposed by the relatively small number of females in the study sample ($N = 150$), which can make it more difficult for relationships between variables to achieve statistical significance.²

Table 11 depicts AUC statistics derived from separate regression models containing LS/CMI total scores, subcomponent scores, and recidivism measures, with the sample partitioned according to gender. For males, the highest AUC statistic ($AUC = 0.619$) is observed for LS/CMI total risk score and *reincarceration*, which indicates that the total score predicts reincarceration approximately 62% of the time. The AUC statistic for total score and

any recidivism is 0.589, illustrating that LS/CMI total risk score predicts recidivism for nearly 59% of males.

For female offenders, results show that the LS/CMI total score accurately predicts reincarceration 60.2% of the time and *any recidivism* in 59% of cases. The highest AUC value for females is found between Companions and *reincarceration* ($AUC = 0.697$). This suggests that the Companions subcomponent is a strong predictor of whether females will be reincarcerated, accurately predicting outcomes in almost 70% of cases. Findings also demonstrate that Alcohol/Drug Problem predicts *any recidivism* for 62.7% of female offenders ($AUC = 0.627$). Similar AUC values in the female portion of the sample are found between Criminal History and *reincarceration* ($AUC = 0.625$), and Alcohol/Drug Problem and *jail booking* ($AUC = 0.618$).

In contrast to the correlation coefficients presented in Table 10, the AUC results indicate that LS/CMI scores successfully predict recidivism outcomes in about the same proportion of cases for female offenders as they do for male offenders. Furthermore, some areas, such as Alcohol/Drug Problem and Leisure/Recreation, are more effective predictors of recidivism outcomes for females than for males. The differences in findings between Tables 10 and 11 are likely due to the fact that the results of AUC analyses are less sensitive to variations

Table 10

Bivariate Correlations by Gender for LS/CMI Total Score and Subcomponent Scores with Jail Booking, Reincarceration, and Any Recidivism (N = 1,288)

	Jail Booking		Reincarceration		Any Recidivism	
	Males (N = 1,138)	Females (N = 150)	Males (N = 1,138)	Females (N = 150)	Males (N = 1,138)	Females (N = 150)
LS/CMI Total Score	0.130***	0.114	0.139***	0.115	0.145***	0.139
Criminal History	0.066*	0.051	0.055	0.164*	0.063*	0.092
Education/Employment	0.117***	0.090	0.101**	0.004	0.125***	0.124
Family/Marital	0.034	-0.083	0.064*	-0.087	0.044	-0.099
Leisure/Recreation	0.063*	0.117	0.048	0.122	0.072*	0.107
Companions	0.095**	0.098	0.110***	0.251**	0.108***	0.119
Alcohol/Drug Problem	0.055	0.170*	0.093**	0.117	0.073*	0.184*
Procriminal Attitude	0.034	-0.102	0.027	-0.108	0.037	-0.135
Antisocial Pattern	0.104***	0.058	0.118***	0.047	0.116***	0.065

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 11

Area-Under-the-Curve (AUC) Statistics by Gender for LS/CMI Total Score and Subcomponent Scores for Jail Booking, Reincarceration, and Any Recidivism (N = 1,288)

	Jail Booking		Reincarceration		Any Recidivism	
	Males (N = 1,138)	Females (N = 150)	Males (N = 1,138)	Females (N = 150)	Males (N = 1,138)	Females (N = 150)
LS/CMI Total Score	0.580	0.574	0.619	0.602	0.589	0.590
Criminal History	0.536	0.536	0.540	0.625	0.534	0.559
Education/Employment	0.573	0.558	0.585	0.515	0.578	0.578
Family/Marital	0.515	0.552	0.542	0.572	0.520	0.560
Leisure/Recreation	0.534	0.570	0.533	0.599	0.538	0.566
Companions	0.556	0.558	0.585	0.697	0.562	0.569
Alcohol/Drug Problem	0.530	0.618	0.575	0.590	0.541	0.627
Procriminal Attitude	0.517	0.560	0.526	0.587	0.519	0.580
Antisocial Pattern	0.565	0.537	0.593	0.526	0.573	0.541

Note: All AUC statistics are derived from separate logistic regression models that contain only the relevant LS/CMI subcomponent score.

Table 12**Recidivism Rates by LS/CMI Risk Level for Violent Offenders (N = 218)**

	Very Low (N = 2)	Low (N = 29)	Medium (N = 77)	High (N = 89)	Very High (N = 21)	Total (N = 218)
Jail Booking	0	8 (27.6%)	24 (31.2%)	35 (39.3%)	9 (42.9%)	76 (34.9%)
Reincarceration	0	2 (6.9%)	7 (9.1%)	15 (16.9%)	4 (19.0%)	28 (12.8%)
Any Recidivism	0	8 (27.6%)	24 (31.2%)	39 (43.8%)	9 (42.9%)	80 (36.7%)

in sample size and the distribution of dependent variables than correlation coefficients (Van Voorhis et al., 2010).

Predictive Validity of the LS/CMI for Violent Offenders

In order to assess the predictive validity of the LS/CMI for violent offenders, chi-square analyses and AUC analyses were conducted using only offenders who committed violent crimes. Specifically, this subsample (N = 218) of offenders was derived by selecting only those with crimes of murder, robbery, assault, or sex offenses.

The results displayed in Table 12 illustrate that percentages of recidivism for violent offenders increase in accordance with LS/CMI risk levels. Findings related to the *any recidivism* measure show that 27.6% of this subsample

of offenders assessed as low risk recidivated during the follow-up period, while the recidivism rate for medium risk violent offenders is 31.2%. Furthermore, 43.8% of those identified as high risk recidivated, as did 42.9% of violent offenders assessed as very high risk. Similar trends are observed with the measures of *jail booking* and *reincarceration* as recidivism rates of violent offenders increase in a stepwise fashion from very low to very high risk.

Using AUC statistics, Table 13 displays the extent to which violent offenders' LS/CMI total scores and subcomponent scores predict recidivism. AUC statistics were derived from separate regression models containing LS/CMI total score, each subcomponent score, and the *any recidivism* measure. Results show that the LS/CMI

Table 13**Area-Under-the-Curve (AUC) Statistics for LS/CMI Total Score and Subcomponent Scores for Any Recidivism of Violent Offenders (N = 218)**

	Any Recidivism
LS/CMI Total Score	0.613
Criminal History	0.542
Education/Employment	0.621
Family/Marital	0.505
Leisure/Recreation	0.566
Companions	0.557
Alcohol/Drug Problem	0.501
Procriminal Attitude	0.550
Antisocial Pattern	0.646

Report Highlights...

The LS/CMI is an effective predictor of recidivism for violent offenders. As measured by regional jail bookings and reincarceration, recidivism rates for violent offenders increase as LS/CMI risk levels increase.

Area-under-the-curve (AUC) analyses reveal that LS/CMI total score is able to predict recidivism among violent offenders in over 61% of cases.

Antisocial Pattern is the most predictive subcomponent for violent offenders. Scores in this domain are able to predict recidivism of violent offenders in approximately 65% of cases.

is predictive of recidivism for violent offenders, with an AUC value of 0.613 suggesting that an LS/CMI total score can correctly predict outcomes approximately 61% of the time. The most predictive domain for this subpopulation is Antisocial Pattern, with an AUC of 0.646 indicating that the risk score in this category can correctly predict recidivism for approximately 65% of offenders. An AUC of 0.621 for Education/Employment reveals that an offender's score in this subcomponent can correctly predict recidivism outcomes in approximately 62% of cases. Overall, these figures are supportive of the utility of the LS/CMI for violent offenders.

DISCUSSION AND CONCLUSION

This study examined the predictive validity of the LS/CMI for offenders under the supervision of the West Virginia Division of Corrections. Analyses of recidivism rates by risk level, bivariate correlations, area-under-the-curve analyses, and logistic regressions all indicate that the LS/CMI is a significant predictor of recidivism for DOC offenders. Individuals who were assessed as high risk recidivated at higher rates than those identified as low and medium risk. Furthermore, LS/CMI total scores and the scores of six of the eight subcomponents are significantly correlated with recidivism. Additionally, regression analyses demonstrate that LS/CMI total risk score is a significant predictor for all recidivism measures when controlling for confounding factors. Findings indicate that the odds of both future jail bookings and reincarceration increase as LS/CMI scores rise. The results of various subanalyses also provide support for the utility of the LS/CMI for violent offenders, but produced mixed findings concerning the ability of the tool to predict recidivism for female offenders.

Overall, this research finds that the LS/CMI is generally predictive of recidivism for DOC offenders. LS/CMI assessments should continue to be completed and used to guide treatment and supervision decisions. It is expected that predictive validity will improve over time through advances in staff experience and utilization of the tool, as well as continued participation in the extant quality assurance process for West Virginia—Quality Assurance for Treatment Intervention Programs and Supervision (QA-TIPS).

Scores for all LS/CMI subcomponents are significantly correlated with recidivism, except in the Family/Marital

and Procriminal Attitude domains. In particular, the discovery that the Procriminal Attitude/Orientation subcomponent is not a significant predictor of recidivism is unexpected. Procriminal attitudes have consistently been found to be highly predictive of recidivism in prior studies and are considered one of the “Big Four” predictors of recidivism. Further analysis of this domain suggests this result may reflect errors in scoring.

For the sample of offenders used in this study, descriptive statistics indicate that mean scores in Procriminal Attitude are low (1.17 out of 4 possible risk points), and that only 33% of the sample was assessed as medium risk or above on this domain. This percentage is rather low considering the sample consists of state prisoners. Perhaps low predictive power of this domain is due to error resulting in underassessment. The abstract nature of the items and somewhat subjective scoring procedure make Procriminal Attitude arguably one of the most difficult subcomponents to assess. It requires evaluating offenders' attitudes toward crime, conventional society, and their supervision and treatment through an interview process combined with collateral information. Time constraints, interview quality, relationship skills, and other interpersonal dynamics may also affect the accuracy of scores in this domain.

To address these challenges, it is recommended that staff consider the adoption of a supplemental self-report attitudinal scale to assess criminal sentiments in conjunction with the LS/CMI (e.g., Criminal Sentiments Scale-Modified). Criminal sentiments scales or criminal thinking scales provide varying statements and concrete rating systems which can provide additional insight into offender attitudes and beliefs, and may assist in scoring the Procriminal Attitude subcomponent. Targeted training efforts on scoring this domain could also improve its predictive validity. Trainers are encouraged to work toward improving assessment skills in this category among staff, including relationship and interviewing skills (e.g., Motivational Interviewing and Core Correctional Practices) which can impact the quality of assessments. Additionally, facilities are strongly encouraged to continue participating in the established LS/CMI quality assurance process (i.e., QA-TIPS) to identify the reasons for discrepancies or low inter-rater reliability in this domain.

The Family/Marital subcomponent is also found to be less predictive of recidivism than expected. This

subcomponent involves ascertaining the quality of offenders' marital situations or satisfaction with single status, the presence of positive support persons and rewarding relationships, and of criminal influences in the immediate family. To score this item properly requires obtaining corroborative information from family members, close personal contacts, spouses or significant others, visitation records, and other indicators that are reflective of the level of familial prosocial supports. Furthermore, since relationships and living situations often change for offenders during incarceration it can be challenging for correctional staff to accurately determine the conditions that offenders will face upon reentry. It is recommended that DOC administrators reexamine policies or practices that may restrict the capacity of correctional staff to obtain information from family members and other close personal contacts. Interviews or statements from key family members periodically during the incarceration period will help both assessors and case managers score the LS/CMI as well as prepare individual reentry and home plans. Assessors are encouraged to gather and review as much collateral information as available when scoring this component, and consider interviews or other documentation from family members when feasible and appropriate.

Opportunities for Future Research

Overall, this report provides evidence of the predictive validity of the LS/CMI in the West Virginia Division of Corrections. However, there are some contextual factors and data limitations that should be noted. First, this study analyzes data from July 1, 2012, to June 30, 2013. At this time, risk and needs assessment using the LS/CMI was a relatively new practice. The LS/CMI was first implemented in DOC in 2011 and, therefore, most correctional staff had only been working with the tool for a short period of time. As a result, a vast majority of assessors had only participated in the initial trainings and had not yet had the opportunity to participate in trainings³ beyond the initial LS/CMI user certification. Moreover, the quality assurance process currently in use had not been fully implemented in DOC processes. It is expected that the predictive accuracy of the tool will continue as assessors gain greater experience and the impact of the QA-TIPS program is fully realized. In future validation efforts it would be worthwhile to investigate the impact of the implementation of quality assurance

procedures⁴ on the predictive accuracy of LS/CMI scores.

In addition, the mixed findings with regard to the predictive validity of LS/CMI scores for female offenders should be another area of focus for future validation work. Presently, there is ongoing discussion in the empirical literature concerning gender-neutral assessments and the utility of such tools for both males and females. Some researchers support the effectiveness of the LSI tools for female offenders (Andrews, Guzzo, Raynor, Rowe, Rettinger, Brews, & Wormith, 2012; Olver et al., 2013; Rettinger & Andrews, 2010) while others advocate the inclusion of gender-responsive assessments to supplement general risk and needs tools (Van Voorhis, Wright, Salisbury, & Bauman, 2010). While the present study indicates that the LS/CMI is predictive of recidivism for both female and male populations, there were some differences in the predictive utility of specific domains. However, these differences may be a product of the small number of females in the sample. Given the time period for the proposed study, it was not possible to obtain a larger sample of females for the present study. Thus, future validation studies should be able to incorporate a larger sample of females and, thereby, allow for a more rigorous study of gender differences.

Finally, due to the timing of the study and the recent implementation of the LS/CMI in DOC, we were limited to a 12-month follow-up period for the recidivism analyses. While this time frame is sufficient to capture most instances of recidivism (which tend to occur in the first 6-12 months after release) (Huebner & Berg, 2011), a longer follow-up period would provide a more accurate measure of the predictive validity of the LS/CMI (Andrews & Bonta, 2010; Van Voorhis et al., 2010). Moreover, research has also shown that reassessment scores are often more predictive of recidivism than initial assessments. The present study included a large number of initial assessments with very few reassessments due to limitations imposed by the time frame of the study. Future research should reexamine the predictive validity of the LS/CMI using a longer follow-up period and, preferably, assessments completed near release. Staff are trained to regularly reassess offenders to monitor changes in risk and needs, and assess offenders periodically while incarcerated and close to release in order to guide both institutional programming and the development of reentry plans.

The results of this study illustrate the efficacy of the

LS/CMI to predict recidivism of WV DOC inmates. The findings reveal that while the LS/CMI is predictive of recidivism, certain areas could benefit from targeted training and supplemental strategies for staff. The findings also highlight the importance of the proper administration of the LS/CMI to ensure that it is providing the greatest benefit to WV DOC staff and inmates.

ENDNOTES

1. Given the low number of prisoners in the “very low” risk category (N = 5), caution should be used when interpreting the percentage results.
2. The power of statistical tests is conditioned by the number of observations (N) in the study sample. When the N is smaller, statistical tests are less sensitive to correlations between variables, and are therefore less likely to reject the null hypothesis that no statistically significant relationship exists.
3. As described in the statewide LS/CMI User and User Trainer Certification Policy, staff who conduct assessments are required to participate in booster, refresher, and recertification trainings offered by the Justice Center for Evidence Based Practice.
4. Quality Assurance: Treatment Intervention Programs and Supervision (QA-TIPS) is the existing LS/CMI quality assurance process. QA-TIPS assesses the quality of instrument completion, the quality of case management plans, motivational interviewing skills, and relationship skills in order to ensure that all LS/CMI Users and Trainers are adhering to statewide minimum standards.

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