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The Criminal Reimprisonment Estimate Scale (CRES)

A statistical model for predicting risk of reimprisonment

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Aims

The aim of the current study was to describe the development of a statistical tool which allows users to efficiently estimate the probability of an individual returning to custody within two years of release, termed the Criminal Reimprisonment Estimate Scale (CRES). The tool is intended to assist decision making about which offenders should be referred for in-depth risk / needs assessment and case management.

Methods

Logistic regression was used to construct a model linking predictor variables to the probability of reimprisonment to determine variables and combination of variables that optimised predictive validity for reimprisonment.

Results

The following groups of offenders were found to be at greater risk of returning to custody: those who had higher numbers of full-time custodial sentences in a shorter period of time; younger offenders at the time of the first full-time adult imprisonment; Indigenous offenders; offenders who had spent shorter periods of time in the community; offenders who had a conviction for robbery-related or theft-related offences and offenders who had spent shorter length of time in custody. Application of multiple predictive factors to derive a single estimate of risk from the CRES tool resulted in a satisfactory level of discrimination for offender reimprisonment within two years.

Conclusion

Better identification of offenders who are at higher risk of returning to custody, and therefore represent priority targets for intervention, can be achieved by using the CRES tool as a screening method to determine who is referred to more comprehensive forms of assessment.

INTRODUCTION

In the correctional setting, the ability to predict future criminal behaviour allows for decision making about who should be given priority for rehabilitation. That is, it allows for the delivery of interventions to those at greater risk of reoffending. Identifying risk factors, understanding the correlates of offending, and evaluating correctional programs are the three key research and policy priorities of criminal justice systems in Australia (Payne, 2007).

The need to understand correlates of criminal behaviour and to predict such behaviour has generated considerable efforts to develop scales that efficiently and accurately estimate future risk of recidivism. For example, the United Kingdom Home Office developed the Offender Group Reconviction Scale (OGRS), a risk assessment tool that assesses the probability that a convicted offender will be reconvicted at least once within the subsequent period of 2 years (Copas and Marshall, 1998). The initial model and subsequent revisions (Cunliffe and Shepherd, 2007; Whiting and Cuppleditch, 2006) used historical or static risk factors to predict recidivism including age; gender; number of youth custody sentences; number of court appearances; time in years since first conviction; and type of offence. The OGRS also applies a function known as the Copas rate, which is formulated from the offender's number of previous sanctions and time between the current and first sanction. The OGRS was designed to derive a single mathematical measure that reflects both the intensity and length of the offender's criminal career.

More recently, the New South Wales (NSW) Bureau of Crime Statistics and Research employed a similar modelling approach to identify static factors that significantly predicted reconviction, leading to the development of the Group Risk Assessment Model (GRAM: Smith and Jones, 2008a; 2008b). Consistent with the OGRS and its subsequent revisions the GRAM identified a small number of static variables that were highly predictive of subsequent reconviction for juvenile and adult offenders and also for offenders managed in both custody and in the community.

It is noted that actuarial risk assessment tools such as the OGRS and the GRAM assess risk based on historical factors that cannot be changed (static risk factors), as opposed to current psychologically meaningful risk factors that are amenable to change (dynamic risk factors or criminogenic needs: Andrews and Bonta, 1994). Dynamic risk factors include antisocial attitudes and associates, recent employment status, and substance use.

Risk assessment based on static risk factors has efficiency advantages in that data on offender age, criminal record, and other historical factors are readily available in criminal justice settings and tend to be more accurately recorded at the population level (e.g. Bakker et al., 1999) compared to dynamic risk factors. There are also indications that static factors alone can deliver good predictive models for reoffending outcomes. Studies consistently report that stable underlying individual characteristics such as age and prior contact with the criminal justice system are strong predictors of future criminal behaviour (Nagin and Farrington, 1992; cited in Smith and Jones, 2008a). Consistent with this, validation studies of actuarial tools such as the OGRS have shown good discrimination of reoffenders from non-reoffenders (e.g. Copas and Marshall, 1998). In addition, Gottfredson and Gottfredson (1988) noted that although actuarial measures are not considered to be perfect tools to predict recidivism, these measures consistently outperform estimates derived from subjective judgements by relevant experts such as psychologists, psychiatrists, social workers, correctional officers, and parole boards.

While actuarial tools based on static factors have utility in predicting risk of reoffending, there is also a need within criminal justice services to assess dynamic risk factors in order to identify current targets for change in treatment or other case management. In Corrective Services NSW (CSNSW) the primary tool for assessment of both offender risk and criminogenic needs is the Level of Service Inventory – Revised (LSI-R; Andrews and Bonta, 1995). The LSI-R is a widely used comprehensive assessment tool that combines information derived from offender reports, historical data, and clinical judgement to predict the offender's risk of recidivism and to identify specific areas of need that require intervention. It is divided into 10 domains that assess a combination of both static and dynamic factors. Ratings given across all domains provide total scores that can be used to predict offender risk. Additionally, the LSI-R provides a profile of the severity of criminogenic needs through scoring of each of the domains.

The LSI-R may be considered a comprehensive tool for informing various decisions about offender case management because it integrates assessment of domains of criminogenic need with an overall estimate of general reoffending risk. However, such assessments are costly to administer in terms of time, requirements for attainment of relevant professional skills and training, and instrument purchasing. More comprehensive assessment also does not necessarily correspond with more accurate estimates of recidivism. Research by Ringland (2011) found that once there are good measures of criminal history, demographics and current offence the LSI-R scores do not contribute substantial predictive power. Similarly, Gottfredson and Gottfredson (1994) concluded that the most statistically sophisticated recidivism scales may produce predictions that are no better than simple scales and in some respects may yield worse predictions. Recent research on the LSI-R in NSW custodial populations indicated that whereas discrimination for reoffending outcomes was acceptable for many offenders, risk estimates had limited predictive validity for relevant subgroups such as female and Indigenous offenders (Watkins, 2011).

Study aims

Considering the respective usages and advantages of both actuarial risk assessment tools based on readily available static factors and more comprehensive risk / needs assessments such as the LSI-R, there is the potential to apply both in a tiered approach to most efficiently inform offender case management. That is, a simple statistical model for estimating offender risk could be used to assist in deciding who should be referred to more intensive assessment processes. While the GRAM is one existing model for estimating risk of reoffending in local populations, there continues to be a need in Australia for a model that predicts the more serious and resource intensive outcome of reimprisonment.

The aim of the current study was to describe the development of a screening assessment tool for the risk of reimprisonment, which we have named the Criminal Reimprisonment Estimate Scale (CRES), based on the methodology used in the development of the OGRS and the GRAM that provides a probability of an individual returning to custody within two years of release. The initial risk assessment provided by the CRES model was developed with the intention of assisting decision making on who should be referred to comprehensive risk/needs assessment, and therefore to inform selection processes regarding which offenders are given priority for rehabilitative interventions.

METHODS

Sampling

The CRES model was developed on a large dataset of individuals comprising all those offenders who were released from Corrective Services New South Wales (CSNSW) correctional centres between July 2007 and June 2010. A total of 22,986 offenders comprised the study sample. The sampling strategy was intended to permit sufficient power and representativeness in order to derive a statistical model for predicting reimprisonment that is stable across offender groups and over time. The large sample size also enabled the discharge population for any single year to be randomly split into two halves: one half to be used to develop the predictive model and the other half to be used to validate the model. This procedure minimises possible artificial inflation of the predictive power of the model which can occur when a model is validated on the same dataset used for its construction.

Measures

Data on offenders released from CSNSW correctional centres between July 2007 and June 2010 were obtained from the Offender Integrated Management System (OIMS) database. OIMS is an operational database that is used to maintain data about all offenders under the supervision of CSNSW including demographics, historical and index offence variables, results of intake screening and other assessment, and sentence administration data.

For the purposes of this study a number of predictor variables were extracted from OIMS, including those relating to offender demographics (age at intake and exit for index custodial episode; gender; Indigenous status), historical sentencing (age at first full-time imprisonment; number of custodial episodes), and index sentencing episode (most serious offence; duration of imprisonment; time in the community between last release from custody and intake for the index custodial episode).

Derivatives or combinations of predictor variables were also considered as a method of improving model parsimony and predictive power. A modified version of the original Copas rate was created which comprises a single measure that reflects the intensity of the offender's criminal career in relation to full-time imprisonment. As opposed to the OGRS Copas rate which was calculated from number of court appearances (Copas and Marshall, 1998), the CRES Copas rate used the number of full-time custodial sentences. The CRES Copas rate was calculated as follows:

$$\sqrt{\frac{n}{t+5}}$$

In this calculation n comprises the number of full-time custodial episodes, which is then divided by the age at the end of the current custodial episode minus age at the first full-time imprisonment (t) in addition to a constant of 5. The constant is included to approximate a more normal distribution of outcome scores and allow for calculation of a rate for those offenders who are at the beginning of their criminal career. For example, an inmate who has been admitted to full-time custody with 5 sentences, and an inmate with 10 sentences over a 5-year criminal career will both have Copas rate of 1.

Statistical analyses

The outcome variable (reimprisonment) was defined as any return of an offender to CSNSW custody with a new sentence or breach of parole within two years post-release from custody. Chi-square tests of association were used to explore the bivariate relationship between each of the potential predictor variables and reimprisonment.

Logistic regression was then used to construct a model linking predictor variables to the probability of reimprisonment. Stepwise logistic regression techniques with forward selection and backward

elimination were used with deletion criterion set at $\alpha = 0.1$ to determine variables and combination of variables that contributed the most to the predictive ability of the model in terms of reimprisonment.

The Hosmer and Lemeshow test was used to determine how well the model predicted reimprisonment. Model adequacy was also assessed by observing the area under the Receiver Operating Characteristic curve (ROC AUC) and by comparing the model's predictive utility to that of the LSI-R.

To explore the effects of applying the CRES model as a screening tool to determine who is referred to a more comprehensive form of risk assessment, a threshold of predicted probabilities required for an LSI-R assessment was applied and descriptively compared to current practice at CSNSW in relation to LSI-R administration.

RESULTS

Sample characteristics

Table 1 shows the distribution of characteristics of the offender group released from custody from July 2007 to June 2010, in addition to the rates of reimprisonment associated with each of these characteristics. The sample had the following characteristics:

- Mostly male offenders (90.8%);
- The majority of offenders were non-Indigenous (71.5%);
- Most of the sample was 24 years of age or less at the time of first full-time adult imprisonment (65.3%);
- Most of the sample was 34 years of age or less at the beginning of the current custodial episode (63.0%);
- Most of the sample had spent less than 12 months in custody (74.7%);
- The most common category of time when last in the community was "greater than 3 years" (14.1%);
- The most common most serious offence (MSO) was acts intended to cause injury (26.5%) followed by offences against justice procedures, government security and government operations (17.2%) and theft and related offences (10.8%).

Predictors of reimprisonment

Table 2 shows the final logistic regression model that best predicted reimprisonment within two years for offenders in the sample. An odds ratio value of greater than one indicates that the factor is associated with an increase in the odds of reimprisonment, whereas a value of less than one indicates that the factor is associated with a decrease in the odds of reimprisonment.

For example, the CRES Copas rate was found to have an odds ratio of 7.5. This indicates that each unit increase in the CRES Copas rate was associated with an estimated increase in the odds of imprisonment by a multiple of 7.5 or 750%. In contrast, an odds ratio of 0.425 for offenders over 45 years of age indicates that their odds of reimprisonment was 42.5% (or less than half as likely) the odds of the comparison group, which was offenders who were younger than 18 years at the start of their index custodial episode.

Table 1. Characteristics of offenders released from NSW custody between July 2007 and June 2010 and associated rates of reimprisonment within two years of release.

Offender Characteristic	N (%)	Reimprisonment (%)
Gender		
Male	20871 (90.8)	42.9
Female	2115 (9.2)	41.1
Indigenous status		
Non-Indigenous	16446 (71.5)	37.2
Indigenous	6540 (28.5)	56.7
Age		
Under 18	575 (2.5)	64.9
18 – 24	5175 (22.5)	48.8
25 – 34	8742 (38.0)	46.0
35 - 44	5883 (25.6)	39.2
45+	2611 (11.4)	22.9
Duration index custodial episode		
3 months or less	4734 (20.6)	42.4
>3 and up to 6 months	5996 (26.1)	44.0
>6 and up to 12 months	6432 (28.0)	45.3
>1 year and up to 2 years	3242 (14.1)	42.0
> 2 years and up to 3 years	973 (4.2)	40.0
>3 years	1609 (7.0)	32.2
Age at first full-time sentence		
Under 18	5025 (21.9)	63.2
18-24	9977 (43.4)	46.9
25-34	4878 (21.2)	31.1
35-44	1956 (8.5)	16.8
45+	1150 (5.0)	10.8
Time in the community		
No history of prior f/t imprisonment	9003 (39.2)	25.7
3 months or less	2941 (12.8)	68.0
>3 and up to 6 months	2013 (8.8)	65.0
>6 and up to 12 months	2294 (10.0)	58.1
>1 year and up to 2 years	2264 (9.8)	53.3
> 2 years and up to 3 years	1228 (5.3)	49.4
>3 years	3243 (14.1)	32.7
Most serious offence		
Homicide and related offences	234 (1.0)	17.5
Acts intended to cause injury	6082 (26.5)	45.5
Sexual assault and related offences	685 (3.0)	16.4
Dangerous or negligent acts endangering persons	320 (1.4)	25.9
Abduction, harassment and other offences against the person	117 (0.5)	41.0
Robbery, extortion and related offences	1121 (4.9)	48.4
Unlawful entry with intent/burglary, break and enter	2044 (8.9)	59.1
Theft and related offences	2491 (10.8)	55.0
Fraud, deception and related offences	730 (3.2)	23.3
Illicit drug offences	1286 (5.6)	18.4
Prohibited weapons and explosives offences	179 (0.8)	21.8
Property damage and environmental pollution	471 (2.0)	44.4
Public order offences	512 (2.2)	53.7
Traffic and vehicle regulatory offences	1878 (8.2)	25.6
Offences against justice procedures	3957 (17.2)	47.0
Miscellaneous offences	878 (3.8)	43.6

Table 2. Final logistic regression model predicting return to custody within two years of release for offenders released from CSNSW custody between July 2007 and June 2010.

Predictor Variable	Parameter estimate (standard error)	Odds ratio [95% confidence interval]	p
CRES Copas rate	2.015 (0.078)	7.501 [6.443, 8.733]	<0.001
Indigenous	0.385 (0.049)	1.470 [1.335, 1.617]	<0.001
Age at first full-time adult imprisonment	-0.040 (0.004)	0.961 [0.953, 0.969]	<0.001
Age at start of custodial episode			
*Under 18**		1.00	
18-24	-0.869 (0.142)	0.420 [0.317, 0.554]	<0.001
25-34	-0.889 (0.146)	0.411 [0.309, 0.548]	<0.001
35-44	-0.933 (0.155)	0.394 [0.290, 0.533]	<0.001
45+	-0.856 (0.180)	0.425 [0.299, 0.605]	<0.001
Offence type			
*Miscellaneous offences**		1.00	
Homicide and related offences	-0.237 (0.303)	0.789 [0.435, 1.430]	0.434
Acts intended to cause injury	-0.060 (0.124)	0.942 [0.738, 1.202]	0.630
Sexual assault and related offences	-0.208 (0.202)	0.812 [0.547, 1.207]	0.304
Dangerous or negligent acts endangering persons	-0.470 (0.229)	0.625 [0.399, 0.978]	0.040
Abduction, Harassment and other offences against the person	-0.135 (0.338)	0.874 [0.450, 1.696]	0.691
Robbery, extortion and related offences	0.275 (0.156)	1.317 [0.969, 1.789]	0.078
Unlawful entry with intent/burglary, break and enter	0.224 (0.140)	1.250 [0.950, 1.645]	0.110
Theft and related offences	0.011 (0.132)	1.012 [0.781, 1.310]	0.931
Fraud, deception and related offences	-0.840 (0.188)	0.432 [0.299, 0.624]	<0.001
Illicit drug offences	-0.417 (0.164)	0.659 [0.478, 0.910]	0.011
Prohibited and regulated weapons and explosives offences	-0.666 (0.315)	0.514 [0.277, 0.953]	0.034
Property damage and environmental pollution	-0.285 (0.194)	0.752 [0.514, 1.099]	0.141
Public order offences	-0.031 (0.181)	0.969 [0.680, 1.382]	0.863
Traffic and vehicle regulatory offences	-0.591 (0.144)	0.554 [0.418, 0.734]	<0.001
Offences against justice procedures	-0.227 (0.125)	0.797 [0.624, 1.018]	0.069
Length of time in custody			
*3 months or less**		1.00	
>3 and up to 6 months	-0.128 (0.065)	0.880 [0.775, 0.999]	0.048
>6 and up to12 months	-0.158 (0.065)	0.854 [0.751, 0.970]	0.015
> 1year and up to2 years	-0.279 (0.081)	0.757 [0.646, 0.887]	<0.001
> 2 years and up to3 years	-0.141 (0.127)	0.869 [0.677, 1.114]	0.267
> 3 years	-0.324 (0.112)	0.724 [0.581, 0.901]	0.004
Time in the community			
*No time in the community**		1.00	
*3 months or less**	0.654 (0.086)	1.923 [1.623, 2.277]	<0.001
>3 and up to 6 months	0.699 (0.091)	2.011 [1.682, 2.405]	<0.001
>6 and up to12 months	0.402 (0.085)	1.495 [1.265, 1.766]	<0.001
> 1year and up to2 years	0.357 (0.085)	1.428 [1.209, 1.687]	<0.001
> 2 years and up to3 years	0.330 (0.102)	1.391 [1.138, 1.700]	<0.001
> 3 years	-0.111 (0.080)	0.895 [0.765, 1.046]	0.164

**An odds ratio of 1 denotes that the category was used as the reference group in the regression model*

Model adequacy

Coefficients from each of the significant independent predictors of reimprisonment were built into a single regression equation predicting odds of reimprisonment for each individual. This was then converted into a single value estimating the probability of the outcome on a scale between 0 (0% predicted probability of reimprisonment) and 1 (100% predicted probability of reimprisonment). This probability estimate comprised the basis of the CRES tool. For the purposes of development of the tool, ranges of probabilities were also aggregated into five groups (1 = .00 - .19; 2 = .20 – 39; 3 = .40 - .59; 4 = .60 - .79; 5 = .80 - .99) to give five categorisation levels indicating increasing risk of reimprisonment[1].

Within the model building sample of offenders, model adequacy was firstly assessed through the Hosmer-Lemeshow test. When assessed for the five level categorisation of the CRES tool the Hosmer-Lemeshow test statistic failed to reach statistical significance, indicating no significant deviation between observed and expected frequencies within each of the partition groups ($\chi^2(8) = 12.626$, $p = 0.125$). See Table 3 for observed rates of reimprisonment for each of the five predicted probability categories.

The adequacy of the model was also assessed using the area under the curve (ROC AUC) statistic which plots the proportion of true positives (those predicted to be reimprisoned who actually are observed to be reimprisoned) against false positives (those predicted to be reimprisoned who are not actually reimprisoned) at any given cut-off point. It provides the likelihood that an offender who goes on to be reimprisoned will have a higher predicted probability of being reimprisoned compared to an offender who is not subsequently re-imprisoned. As described by Hosmer & Lemeshow (2000), scores greater or equal to 0.9 provide 'outstanding' discrimination, scores between 0.8 and 0.9 provide 'excellent' discrimination, scores between 0.7 and 0.8 provide 'acceptable' discrimination. Scores of 0.5 predict outcome at chance level.

In the current study, the AUC statistic yielded a value of 0.790 for the final CRES model, showing that the tool provided acceptable discrimination approaching excellent discrimination.

Table 3. Reimprisonment rate within two years by predicted probability group.

Predicted Probability Group	Reimprisonment within 2 years		Total
	Not reimprisoned	Reimprisoned	
1	88.7%	11.3%	100.0%
2	69.6%	30.4%	100.0%
3	49.4%	50.6%	100.0%
4	31.1%	68.9%	100.0%
5	15.8%	84.2%	100.0%
Total	57.3%	42.7%	100.0%

Model validation

As previously mentioned, this study incorporated model verification methods by developing the CRES tool equation on one subsample (n = 11, 431) and validating the tool by assessing predicted against observed outcomes for a second subsample (n = 11, 555). Tables 4 and 5 display the observed and predicted reimprisonment rates for the selected sample used to derive the model and also for the unselected sample used to validate the model, stratified by financial year of release from custody.

The 'percent correctly predicted' method previously used by Copas (1992) and May (1999) was employed to depict how well the model estimated risk of returning to custody. The range

[1] Other categorisation methods were also tested (e.g. 10 levels). The 5 level categorisation was deemed to have greatest utility by adequately capturing probability variance across groups and allowing for comparability with existing categorisations on the LSI-R.

of predictor values were divided into 'high' and 'low' at the point corresponding to the proportions observed to return to custody and not return to custody. All 'high' scores were treated as predicting return to custody and all low scores as predicting non-return to custody. Return to custody high scorers and non-return to custody low scorers were counted as 'correct' predictions.

The percentage of offenders that were correctly identified as either not returning to custody or returning to custody was consistent across time ranging from 70.4% to 73.3% (Table 4). As outlined by Raynor and colleagues (2000), the percentage of offenders correctly predicted as either re-offending or not re-offending typically is not expected to exceed 75% (even for optimal predictors) if the observed reconviction rate is 50%. Importantly, rates of correctly predicted cases were similar for the model building and the model verification samples and across the three year of release cohorts.

Table 4. Predicted and observed rates of reimprisonment among offenders released from CSNSW custody in the years of 2008, 2009, and 2010, for model building and model verification samples.

			Predicted Outcome					
			Selected cases (model building) n=11,431			Unselected cases (model verification) n=11,555		
	Sample Year		Not reimprisoned	Reimprisoned	% correct	Not reimprisoned	Reimprisoned	% correct
Observed Outcome	2008	Not reimprisoned	1715 (46.2)	433 (11.7)		1642 (44.9)	450 (12.3)	
		Reimprisoned	626 (16.9)	936 (25.2)		633 (17.3)	930 (25.4)	
					71.5%			70.4%
	2009	Not reimprisoned	1657 (44.1)	472 (12.6)		1740 (45.0)	450 (11.6)	
		Reimprisoned	571 (15.2)	1057 (28.1)		581 (15.0)	1096 (28.3)	
					72.2%			73.3%
	2010	Not reimprisoned	1763 (44.5)	504 (12.7)		1786 (44.3)	548 (13.6)	
		Reimprisoned	586 (14.8)	1111 (28.0)		542 (13.4)	1157 (28.7)	
					72.5%			73.0%
	Total	Not reimprisoned	5135 (44.9)	1409 (12.3)		5168 (44.7)	1448 (12.5)	
		Reimprisoned	1783 (15.6)	3104 (27.2)		1756 (15.2)	3183 (27.5)	
Total Correct					72.1%			72.3%

Table 5. Discrimination accuracy by year and type of sample, for model building and model verification samples.

			Predicted Outcome					
			Selected cases (model building)			Unselected cases (model verification)		
	Sample Year		Not reimprisoned	Reimprisoned	Total n (%)	Not reimprisoned	Reimprisoned	Total n (%)
Observed Outcome	2008	Not reimprisoned	1715 (79.8) (73.3)	433 (20.2) (31.6)	2148 (100)	1642 (78.5) (72.2)	450 (21.5) (32.6)	2092 (100)
		Reimprisoned	626 (40.1) (26.7)	936 (59.9) (68.4)	1562 (100)	633 (40.5) (27.8)	930 (59.5) (67.4)	1563 (100)
		Total n (%)	2341 (100)	1369 (100)		2275 (100)	1380 (100)	
	2009	Not reimprisoned	1657 (77.8) (74.4)	472 (22.2) (30.9)	2129 (100)	1740 (79.4) (75.0)	450 (20.6) (29.1)	2190 (100)
		Reimprisoned	571 (35.1) (25.6)	1057 (64.9) (69.1)	1628 (100)	581 (34.6) (25.0)	1096 (65.4) (70.9)	1677 (100)
		Total n (%)	2228 (100)	1529 (100)		2321 (100)	1546 (100)	
	2010	Not reimprisoned	1763 (77.78) (75.0)	504 (22.2) (31.2)	2267 (100)	1786 (76.5) (76.7)	548 (23.5) (32.1)	2334 (100)
		Reimprisoned	586 (34.5) (24.9)	1111 (65.5) (68.8)	1697 (100)	542 (31.9) (23.3)	1157 (68.1) (67.9)	1699 (100)
		Total n (%)	2349 (100)	1615 (100)		2328 (100)	1705 (100)	
	Total Sample	Not reimprisoned	5135 (78.5) (74.2)	1409 (21.5) (31.2)	6544 (100)	5168 (78.1) (74.6)	1448 (21.9) (31.3)	6616 (100)
		Reimprisoned	1783 (36.5) (25.8)	3104 (63.5) (68.8)	4887 (100)	1756 (35.5) (25.4)	3183 (64.5) (68.7)	4939 (100)
		Total n (%)	6918 (100)	4513 (100)		6924 (100)	4631 (100)	

Table 5 also shows discrimination accuracy of the CRES tool by year. It can be seen that more non-recidivists were correctly identified compared to recidivists. Specificity rates were therefore consistently higher than sensitivity rates across the study samples. Again, sensitivity and specificity rates were observed to be similar for the model building and model verification samples and across the three year of release cohorts.

Operational utility

The results of model adequacy and model verification analyses indicated that the CRES tool has validity in predicting risk of reimprisonment within two years. A further aim of this study was to examine relative utility of the tool when compared to current CSNSW practices for assessing offender risk, which is through administration of the LSI-R.

As previously mentioned an earlier study from our research team (Watkins, 2011) examined the predictive validity of the LSI-R for reimprisonment within two years of release, for a sample of 11,051 released from CSNSW correctional centres between January 2005 and January 2008. Results from this study indicated AUC values of .690 for continuous LSI-R total scores and .677 for the five level risk classification. This indicates that the CRES tool returned higher discrimination accuracy (AUC = .790) in a similar, although more recent, sample of offenders and using similar definitions of outcome.

In addition to predictive validity, another important consideration for relative utility of the CRES tool is whether it can improve risk identification and triage processes compared to current practice using the LSI-R. At present, only a subset of offenders under CSNSW supervision complete the LSI-R as a result of resourcing and eligibility constraints; offenders for whom an LSI-R assessment is not feasible or prioritised do not receive an estimate of their risk of reoffending. In the study sample, for example, around one third of offenders (7,669 of 22,986) did not have an LSI-R completed.

Figure 1 indicates that the current practice of selective LSI-R administration is not efficiently aligned with offender risk. For example, in the study sample 3,183 offenders who did not complete an LSI-R returned to custody within two years (41.5% of those without an LSI-R), and 8,674 offenders who did complete an LSI-R did not return to custody within two years (56.6% of those with an LSI-R). This equates to a misalignment rate between LSI-R administration and recidivism outcome of 52%.

To illustrate the utility of the CRES tool as a method of screening prioritisation for more comprehensive assessment using the LSI-R, Figure 1 also shows the results of a hypothetical modelling scenario whereby only those offenders with a score of 2 or higher were allocated to further assessment. Had this screening criterion on the CRES tool been adopted as the basis for LSI-R administration to the current sample (requiring administration to 17,594 offenders or 77% of the sample), a total of 611 offenders without an LSI-R would have been reimprisoned (2.7%) and 8,379 offenders with an LSI-R would not have been reimprisoned (36.4%). This equates to a misalignment rate between LSI-R administration and recidivism outcome of 39%.

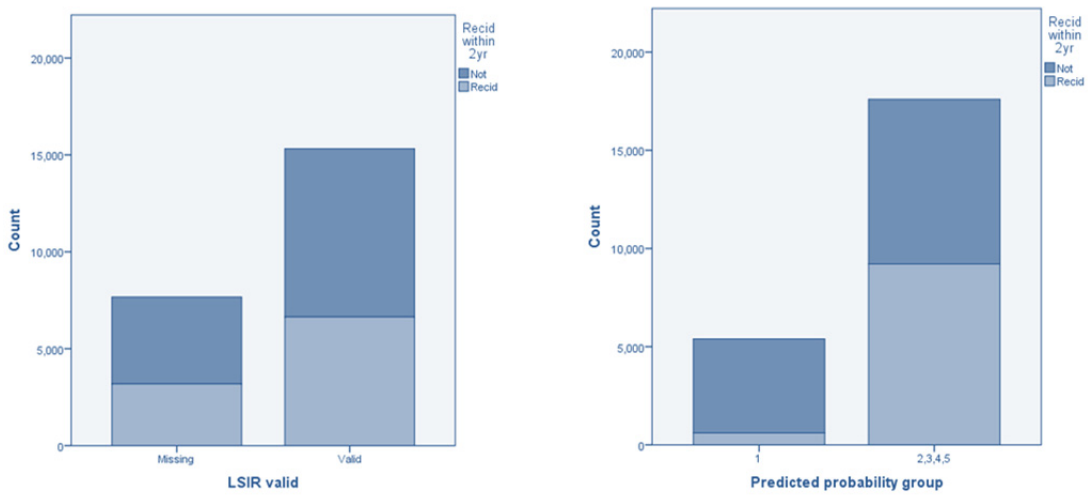

Figure 1. Comparison between the CRES model as a screening tool (LSI-R delivered to medium low and above only) and current practice in relation to LSI-R administration by reimprisonment status.

DISCUSSION

The aim of this study was to apply regression modelling techniques to develop a risk assessment tool that could efficiently and accurately predict the probability of a custody-based offender returning to prison within two years of release. The results support the notion that criminal history and basic demographic data can be used to assign probabilities of offenders returning to custody. The strongest predictor of returning to custody was our modified CRES Copas rate which combined number of full-time custodial sentences with the length of the offender's criminal career. The more prior convictions the offender had within a shorter period of time, the more likely the offender was to return to custody.

Other demographic and criminogenic characteristics also predicted significant variance in the likelihood of an offender returning to custody. These included being younger at the time of the first full-time adult imprisonment, being an Indigenous Australian, having spent less time in the community between the current and the previous incarceration episode, having a current MSO for robbery, extortion and related offences or unlawful entry with intent/burglary break and enter or for theft and related offences and having spent a shorter length of time in custody. The model was consistent across time with the proportion of offenders correctly identified as either predicted to return to custody or not predicted to return to custody remaining stable across the financial years of 2008 to 2010.

In the current study gender was not a significant predictor of returning to custody. When explaining why one recidivism study with a non-custodial sample yielded significant effects of gender whereas a similar study with a custodial sample did not, Smith and Jones (2008b) suggested that once offending has reached the threshold resulting in a custodial sentence (which is known to be higher for females than males), the differences between male and female may become suppressed.

Also noteworthy is the finding that Indigenous offenders were 47% more likely to be reimprisoned compared to their non-Indigenous counterparts. Although Australia is an affluent country, even by OECD standards, the Indigenous segment of the Australian society experiences significant poverty and social exclusion. Further research is needed to understand the determinants of Indigenous disadvantage in relation to imprisonment. It should be noted, however, that in this study Indigenous status was employed solely as a statistical proxy for observed variance across individuals that was associated with risk of reimprisonment. The results do not provide any information about (and should not be interpreted as evidence for) meaningful causal or independent relationships between Indigenous status and criminal justice outcomes.

In addition to showing evidence of predictive validity, the results of this study indicated that the CRES tool has potential operational utility when compared to current CSNSW practice, which involves selective administration of the LSI-R to offenders to estimate their risk and case management needs. The CRES tool was found to have better discrimination accuracy for reimprisonment compared to that of the LSI-R, as reported in a previous study using similar samples and recidivism definitions (Watkins, 2011). This result is consistent with previous indications (e.g. Ringland, 2011) that actuarial predictions of risk may be primarily facilitated by strong measures of criminal history, after which information about more dynamic factors such as those provided by LSI-R scores add limited predictive power.

Further, hypothetical modelling indicated that use of the CRES tool as a screening method for allocating custody-based offenders to more comprehensive assessment with the LSI-R can substantially improve targeting of offenders who are more likely to be reimprisoned. Considering

that the CRES tool was designed to assess risk only and does not provide all information that is relevant to case management of offenders, our results support the intended operational use of the CRES tool as an instrument for effectively triaging offenders to other case planning and assessment resources.

Limitations

The CRES tool only assesses static risk factors, as opposed to criminogenic needs and responsivity factors, and is therefore only intended to determine risk of reimprisonment among custody-based offenders and not to determine what intervention strategies should be delivered to a particular offender. In addition, although the CRES model can be used as a screening tool to determine who receives comprehensive risk/needs assessment, we acknowledge that other factors are important to operational decision making about targets for assessment and case management. For example, there are practical constraints to administering in-depth assessments and developing case plans for offenders who have short sentences.

It is also acknowledged that the modelling applied to this study only uses data on offender characteristics that are readily available in the context of correctional supervision. Most certainly there would be other predictors of reimprisonment that were not available from local data sources and are therefore not included in development of the CRES tool.

As argued by Smith and Jones (2008b), probabilistic models of recidivism such as the CRES tool inevitably identify a proportion of offenders who do not go on to reoffend as having high risk. There are ethical and moral considerations to using probabilistic models alone to assess risk of being reimprisoned for an individual offender for the purposes of making decisions on parole or release. As previously mentioned the CRES model was intended to triage individuals into more comprehensive risk/needs assessment.

Finally, there are many factors that can influence an offender's risk of reimprisonment including treatment effects of interventions and changes in government policy and policing. The CRES model was developed with a static cohort of offenders and may be expected to show reduced validity as the nature of the population or criminal justice context changes over time. The model will need to be periodically recalibrated to account for changes in the relationship between the predictor variables and likelihood of reimprisonment.

Conclusions

The results of this study showed that relatively accurate identification of offenders' risk of returning to custody can be achieved by using the CRES tool. The tool therefore represents a practical and efficient method of assisting decision making about who should be referred to more comprehensive assessment and other case management processes, such as administration of the LSI-R. This has clear potential for optimising resource allocation in the correctional setting. Because the CRES tool uses a small number of readily available static variables it has scope to be applied to all offenders in custody using automated or in-built data analysis routines, thus allowing for a more systematic understanding of risk and intervention priorities in the population compared to current selective, manual assessment methods.

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