

## Exploring the relationship between intervention dosage and reoffending: Evidence from an integrated intervention delivery model in NSW correctional centres

Yatin Mahajan, Anindita Sarker, Chee Seng Chong & Mark Howard

### Aims

The intensity of intervention delivered in correctional settings should align with an individual's risk of reoffending. However, there is limited empirical evidence from Australian custodial environments regarding the nature of the relationship between intervention dosage and reoffending rates, or the optimal dosage levels required to achieve outcomes. This study leverages Corrective Services NSW's innovative custodial intervention model (Intervention Pathways model) to investigate the link between dosage and reoffending.

### Methods

Logistic regression modelling was used to investigate the relationship between dosage (measured in hours) and reoffending outcomes (general reoffending and serious reoffending) among 1248 individuals who completed their assigned interventions between July 2020 and July 2022. Dosage was analysed both as a continuous variable and across discrete categories. We also assessed how individuals' risk of reoffending influenced dose-response relationships.

### Results

A linear dose-response relationship was observed when dosage was treated as a continuous variable, indicating that increased intervention hours were associated with reduced general reoffending. However, when dosage was grouped into discrete categories, non-linear patterns were observed. Dosage levels between 101 and 250 hours were associated with reduced rates of serious reoffending. No significant differences were observed between specific dosage intervals within this range. Notably, these dose-response relationships were only observed among individuals with a moderate risk of reoffending but not for those with very high risk.

### Conclusion

These findings offer insights to inform effective dosage in custodial correctional settings, and underscore the importance of tailoring intervention dosage to an individual's assessed risk level. Future research should investigate the mechanisms underlying differential dosage effects and explore how dosage can be optimised to enhance intervention outcomes across diverse risk profiles.

---

## INTRODUCTION

---

Across jurisdictions, the Risk-Needs-Responsivity (RNR) model of correctional rehabilitation has been the cornerstone of various interventions and services aimed at reducing reoffending (Lutz et al., 2022). The RNR model is underpinned by three core principles: 1) the risk principle states that intensity of interventions should match an individual's risk of reoffending; 2) the need principle states that interventions should address an individual's criminogenic needs; and 3) the responsivity principle states that interventions should be delivered in a manner that accommodates an individual's learning style, abilities, and strengths (Bonta & Andrews, 2016).

While substantial research has indicated that correctional interventions that adhere to the RNR model can effectively reduce reoffending, most of this evidence stems from study designs that use between-group comparisons (Andrews & Dowden, 2006; Koehler et al., 2013; Latessa et al., 2010; O'Donnell, 2020; Peters et al., 2001; Sperber & Lowenkamp, 2017; Swartz et al., 1996). For example, studies tend to compare outcomes of those who received RNR-based treatment against those who either received no or minimal treatment (Andrews & Dowden, 2006; Latessa et al., 2010; O'Donnell, 2020; Sperber & Lowenkamp, 2017), did not complete or spent less time in their treatment (Peters et al., 2015; Swartz et al., 1996), or were on treatment waitlists (Beaudry et al., 2021). This focus on group-based comparisons, however, means that the dose-response relationship, or the intensity of treatment required to effect behaviour change and reduce

reoffending, remains largely unexplored (Bower et al., 2024; Simourd & Olver, 2019).

Understanding the nature of the dose-response relationship is critical for policymakers, as it would assist them in developing targeted intervention strategies and goals. However, there are only a few studies that have investigated the relationship between the intensity of intervention dosage and reoffending outcomes (Bourgon & Armstrong, 2005; Makarios et al., 2014; Sperber et al., 2013). Deriving generalisable conclusions applicable to the Australian custodial context from these limited studies is problematic, as they examine different programs and cohorts, and originate from just two North American jurisdictions. For example, to reduce reoffending, delivering more than 250 hours of custody-based programs (Bourgon & Armstrong, 2005) have been deemed sufficient for higher risk individuals. Conversely, the most significant reductions in reoffending were observed in medium to higher risk individuals who engaged in 100 and 200 hours or between 200 and 249 hours of cognitive-behavioural therapy (CBT)-based interventions within a community-based program (Makarios et al., 2014; Sperber et al., 2013).

Further complicating the evidence base, these studies also found that the dose-response relationships may not be linear, implying that increasing dosage hours does not always result in a proportional decrease in reoffending rates (Makarios et al., 2014; Sperber et al., 2013). A non-linear relationship suggests that the efficacy of intervention may plateau at a certain dosage threshold, and both low (underdosage) and very high intensities (overdosage) may offer limited benefits or be detrimental to reoffending outcomes.

Relatedly, these non-linear dose-response relationships can vary as a function of the individual's reoffending risk (Andrews & Bonta, 2014; Bourgon & Armstrong, 2005). For example, for people at higher risk, increasing dosage is linked to a decrease in reoffending only up to a certain extent. For those at lower risk, higher dosage may result in limited effects or even an increased likelihood of reoffending (Bonta & Andrews, 2016; Latessa et al., 2010; Makarios et al., 2014; Sperber & Lowenkamp, 2017). This suggests that a one-size-fits-all approach to intervention dosage is unlikely to be effective and must be tailored to individual risk profiles. While such considerations are in line with the well-established risk principle of the RNR model, there remains a paucity and inconsistency of empirical evidence about the relationship between intervention dosage and reoffending outcomes to guide application of this principle in practice.

## The current study

Corrective Services NSW implemented a new intervention delivery model across all its correctional centres in 2020. The Intervention Pathways (IP) model was designed to identify and deliver tailored intervention dosage to higher risk individuals in custody, within the constraints of their sentence length (Mahajan et al., 2024a, 2024b). The IP model aims to address the logistical and administrative barriers that may negatively impact the delivery of dosage to higher risk individuals (Bower et al., 2024). It employs an integrated system of assessments for program eligibility and suitability, as well as allocation to various intervention pathways which provides targeted dosage through a cluster of intensive criminogenic and non-criminogenic interventions, reintegration services, education

programs, and other offence-specific case management activities (Mahajan et al., 2024a).

The IP model offers a unique opportunity to advance empirical research on dose-response relationships. Firstly, the IP model encompasses a variety of interventions, enabling us to conceptualise dose-response relationships from a broader, more holistic perspective, which includes the types of interventions and services that an individual typically engages in while in custody. Previous studies on dose-response relationships have primarily focused on dosage from CBT-based criminogenic interventions (Bourgon & Armstrong, 2005; Makarios et al., 2014; Sperber et al., 2013). However, individuals in correctional facilities often engage in multiple programs and services beyond CBT-based interventions (Frolich, 2002; Hsieh et al., 2022) which may also have a positive impact on reducing reoffending (Duwe, 2018; Lipsey et al., 2007; Sperber et al., 2013) and should therefore be considered as a form of intervention dosage.

Secondly, the IP model provides a standardised framework for documenting and recording intervention dosage, ensuring consistent and reliable data on delivered dosage and completion status across intervention pathways. This allows for a nuanced examination of dosage among motivated and engaged individuals who complete their allocated interventions, while also mitigating the confounding impact of program attrition on dosage metrics. Third, as only individuals who are assessed as being at higher risk of recidivism are eligible for the IP model, this provides an opportunity to assess dose-response relationships while exploring and accounting for baseline risk. For example, individuals at a greater risk of reoffending typically present with

---

significant needs and consequently receive more intensive interventions.

A recent evaluation of the IP model found that whereas individuals who completed their allocated interventions received an average of 194 hours of dosage, the varying content of different intervention pathways permitted individuals to reach completion over a range of 66 to 473 hours in total (Mahajan et al., 2024a). This broad range of dosage, encompassing dosage levels cited in previous studies, allows us to examine whether a dose-response relationship exists among those who completed assigned interventions. If a dose-response relationship is observed, we aimed to explore its nature further by determining whether it is possible to establish a dosage range associated with optimal reoffending outcomes, and identifying signs of under- or overdosage.

This study examined the relationship between reoffending outcomes and dosage at both continuous and discrete categorical levels, following the dosage thresholds used by Makarios et al. (2014) (i.e., 0-50 hours, 50-100 hours, etc.). While only higher-risk individuals are eligible to participate in the IP model, we further explored dose-response relationships by dividing these individuals into moderately high and very high risk of reoffending to provide a more nuanced perspective on the nature of these relationships.

## METHODS

---

### Participants

The sample comprised 1,248 individuals (1,164 males and 84 females) who had completed their

allocated interventions before being released from custody between July 1, 2020, and July 31, 2022. Of these individuals, 39% (n = 480) identified as Aboriginal (for the purposes of this report, we hereafter use the term 'Aboriginal' to refer to all First Nations Australians including Aboriginal and Torres Strait Islander peoples). Individuals' ages ranged from 19 to 69 years, with a mean of 35.7 years (SD = 8.2). The number of months individuals spent in custody ranged between 2.2 and 971, with an average of 43.1 months (SD = 7.3). In line with the eligibility thresholds used in the IP model, only individuals with an estimated general reoffending risk of 35% or higher were included in this study. The risk of reoffending was estimated using the Custody Triage Risk Assessment Scale (Custody TRAS). This is an automated actuarial risk assessment tool that defines reoffending as any return to custody with a new conviction within two years of release from custody (Raudino et al., 2019).

Individuals completed interventions in one of the eight primary intervention pathways (see Mahajan et al., 2024a). These pathways included High Intensity Program Units (HIPU), the Short Sentence Intervention Program (SSIP), the Violent Offender Therapeutic Program (VOTP), Sex Offender Programs (SOP), the Intensive Drug and Alcohol Treatment Program (IDATP), the Young Adult Offender Program (YAOP), the Macquarie Intensive Program (MIP) and the Explore, Question, Understand, Investigate, Practice, Succeed (EQUIPS) suite of programs. Individuals who commenced their custodial sentences before the implementation of the IP model but had since been allocated and completed interventions were also included in the sample. We considered only the most recent

intervention pathway completion in instances of multiple completions within the observation period. Table 1 outlines the number of individuals across eight intervention pathways who completed their assigned interventions.

**Table 1.** Distribution of the sample in the current study.

Variable	n	%
<b>Pathways</b>		
HIPU	823	66%
EQUIPS	35	3%
SSIP	184	15%
VOTP	79	5%
SOP	16	1%
IDATP	24	2%
YAOP	56	5%
MIP	31	3%
Total	1248	100%
<b>Dosage Categories</b>		
0 - 50 hours	90	7%
51 - 100 hours	144	12%
101 - 150 hours	385	31%
151 - 200 hours	354	28%
201 - 250 hours	123	10%
>250 hours	152	12%

## Data Sources

**Offender Integrated Management System (OIMS).** OIMS is the central operational database Corrective Services NSW maintains to support the management of inmates in custody and under supervision in the community. For the current study, the variables extracted from OIMS were the individual's date of birth, gender, Aboriginal status, sentence-related information, and the Custody TRAS score at release. Intervention-related data, such as program participation status, criminogenic and non-criminogenic/other program dosage, services, and reintegration

dosage hours and education program hours delivered to individuals, were also extracted.

**The Reoffending Database (ROD).** Maintained by the NSW Bureau of Crime Statistics and Research (BOCSAR), the ROD database contains records of outcomes of every individual who has appeared in court in NSW. For the current study, data on all finalised convictions for the current sample were extracted up to 31 March 2024.

## Data

### Dosage

The data examined in this study included the total dosage delivered to individuals who completed their enrolled intervention pathway under the IP model. Dosage comprised the total hours each individual received engaging in the following intervention programs and services categories<sup>1</sup>:

- *Criminogenic/Intensive Programs:*  
HIPU; VOTP; SOP; IDATP; EQUIPS; YAOP; SSIP, MIP.
- *Non-criminogenic/Other Programs:*  
Real Understanding of Self-Help (RUSH); CONNECT; Cultural Strengthening Programs; Traffic Intervention Program; Well-being and Parenting Programs.
- *Services:*  
Case Management; HIPU Reintegration; In-Cell Programs
- *Reintegration:*  
NEXUS and its variants.
- *Education Programs:*  
Foundational, Vocational, Intensive Learning Centre-mediated programs.

<sup>1</sup> Details of various intervention programs and services are available in the CSNSW Compendium of Offender Behaviour Change Programs: [https://correctiveservices.dcj.nsw.gov.au/documents/programs/CSNSW\\_Compndium\\_of\\_Offender-Behaviour\\_Change\\_Programs.pdf](https://correctiveservices.dcj.nsw.gov.au/documents/programs/CSNSW_Compndium_of_Offender-Behaviour_Change_Programs.pdf)

---

Dosage was calculated as a continuous variable (aggregate hours), as well as in categories of 50-hour increments up to 250 hours. Table 1 presents these dosage categories and corresponding sample sizes. The lowest dosage group (0-50 hours) comprised 7% (n = 90) of the total sample, while the highest dosage group consisted of 12% (n = 152) of the total sample.

### Estimated risk of reoffending

The Custody TRAS was used to estimate each individual's risk of reoffending. The average Custody TRAS score among the sample in this study was .54 (SD = .12). Scores ranged between .35 and .87, which can be interpreted as between 35% and 87% estimated probability of general reoffending within two years (Raudino et al., 2019). The Custody TRAS scores were divided into two risk level groups by performing a median split on individuals' scores. Those with Custody TRAS scores below the median value of .52 were grouped as 'TRAS-1' (n = 628, 50.2%) and those above .52 were grouped as 'TRAS-2' (n = 620, 49.6%).

### Reoffending

This study considered two reoffending outcomes: general reoffending and serious reoffending. General reoffending was defined as any finalised instance of conviction for a new offence during the 12 months following release from custody. Serious reoffending was defined as any new finalised conviction within 12 months post-release for certain offences, including homicide, acts intended to cause injury, sexual assault, abduction and kidnapping, robbery, extortion, unlawful entry with intent, theft, fraud, deception, and illicit drug-related offences. Of the total sample, 64% (n = 799) were recorded as

being reconvicted for a general offence, and 40% (n = 490) were reconvicted for a serious offence within 12 months post-release.

We examined both general and serious reoffending for two primary reasons. First, general reoffending aligns with existing research and encompasses a broader range of criminal offences. Second, serious offences are more likely to be formally prosecuted and recorded, providing a more robust and reliable outcome measure. Additionally, the interventions delivered under the IP model primarily target risk factors and needs associated with serious reoffending.

### Analytical plan

The initial step of data analysis involved limiting extreme dosage values (outliers; > 400 hours, n = 68). To address these outliers, we used winsorising by replacing extreme values with the nearest non-outlier dosage (401 hours). Winsorising is a statistical method that reduces the impact of outliers on the mean and variance by substituting extreme values with less extreme ones from the same dataset (Blaine, 2018). Then, separate binary logistic regression models were developed for general and serious reoffending outcomes to estimate their relationship with dosage. Effects were estimated using covariate-adjusted logistic models to produce more robust and precise treatment effects (Jiang et al., 2017).

In the first regression model, to detect the presence of a dose-response relationship, the winsorised dosage delivered under the IP model (as a continuous variable) was used as the primary predictor. Individuals' age, Aboriginal status, Custody TRAS score, and months served

in custody were included as covariates in the model. While dosage, age, Custody TRAS scores, and months in custody were treated as continuous variables, Aboriginal status was considered as a categorical variable, with non-Aboriginal status as the reference category.

The second model examined whether dosage, defined as categorical variables, predicted reoffending outcomes while controlling for the confounding effects of covariates. The effect for each dosage category was estimated in reference to the lowest dosage category (0-50 hours).

Finally, to determine if dose-response relationships varied as a function of the individual's reoffending risk, the second model was revised separately for the TRAS-1 and TRAS-2 groups, respectively. Across each group, the primary predictors were the six discrete dosage categories referenced to the lowest dosage category.

## RESULTS

### Relationship between dosage and reoffending

Table 2 presents the results of covariate-controlled logistic regression models examining the relationship between continuous dosage and two reoffending outcomes. For general reoffending, several covariates, including age, Custody TRAS, and time spent in custody, were significant. After adjusting for covariates, we found a significant relationship between the continuous indicator of dosage and general reoffending. The odds of general reoffending reduced by 2% with every 1-hour increase in

dosage. The left panel of Figure 1 shows the relationship between dosage and the probability of general reoffending.

For serious reoffending, covariates including Custody TRAS score, and time spent in custody were significant. However, after controlling for all covariates, we did not find a significant relationship between dosage and serious reoffending. Figure 1 (right panel) shows that, although the association was not significant, a decreasing trend in the relationship between continuous dosage and the odds of serious reoffending was apparent.

### Relationship between dosage categories and reoffending

To further examine dose-response relationships, we grouped dosage into discrete categories in 50-hour increments. Table 3 presents the results of logistic regression models which compared the odds of reoffending across different dosage categories against 0-50 hours as the reference category.

Overall, there was an indication that all dosage levels resulted in a reduction in the likelihood of general reoffending when compared to the reference 0-50 hours category (Figure 2, left panel). These differences, however, were not significant, with marginal effects observed only for two dosage categories; receiving 101-150 hours and 201-250 hours of dosage was marginally associated with a 38% and 44% decrease in the likelihood of general reoffending, respectively, compared to 0-50 hours.

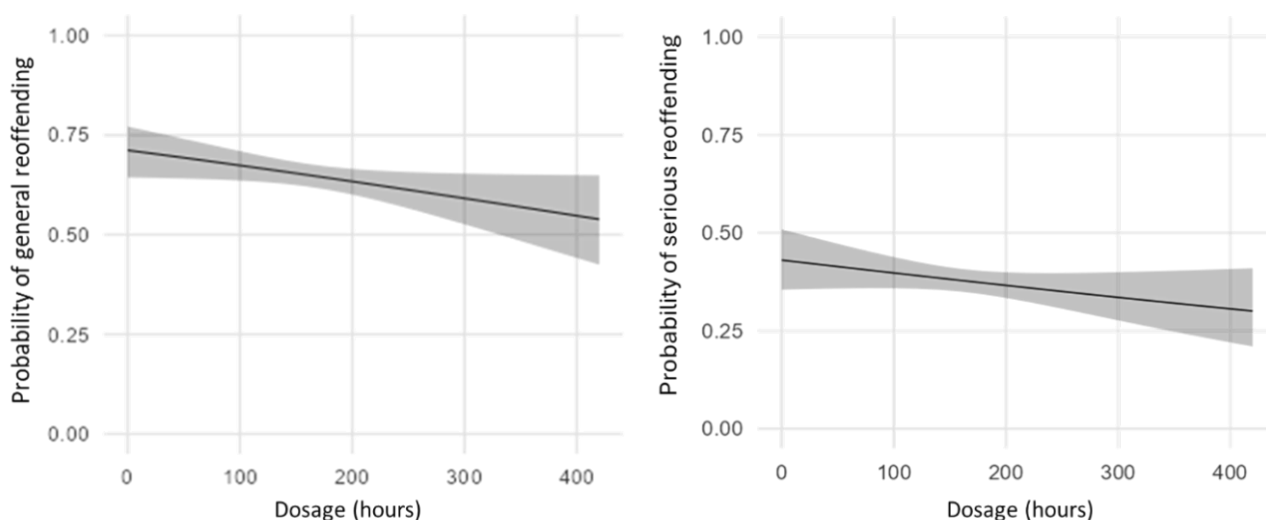
The dose-response relationship for serious reoffending exhibited a different pattern. All dosage categories appeared to reduce the odds

of reoffending when compared to 0-50 hours, with an incremental reduction in reoffending between 0-50 and 201-250 hours, followed by increased reoffending rates for individuals who received more than 250 hours of dosage (see Figure 2, right panel). While receiving 101-150 hours was associated with a 27% decrease and 150-200 hours with a 41% decrease, receiving 201-250 hours of dosage was associated with a substantial 50% decrease in the likelihood of serious reoffending, compared to those who received 0-50 hours of dosage. Interestingly, the odds of reoffending for those who received more than 250 hours were not significantly different from 0-50 hours (see Table 3, right panel).

However, further analysis revealed that odds of reoffending did not differ significantly between 101-150 hours and the other higher dosage categories (151-200 hours:  $B = -.06$ ,  $OR = .94$ , 95%  $CI [.69, 1.27]$ ,  $p = .69$ ; 201-250 hours:  $B = -.23$ ,  $OR = .79$ , 95%  $CI [.51, 1.23]$ ,  $p = .30$ ) including those who received greater than 250 hours ( $B = .11$ ,  $OR = 1.12$ , 95%  $CI [.69, 1.84]$ ,  $p = .64$ ). These findings suggests that 101-150 hours represent the threshold for measurable effect of dosage on serious reoffending and that the effects plateaued after reaching this threshold. While non-significant, the pattern of results also suggests a contraction of effect sizes which could be indicative of overdosage when more than 250 hours of dosage were delivered.

**Table 2.** Logistic regression modelling of continuous dosage and reoffending outcomes.

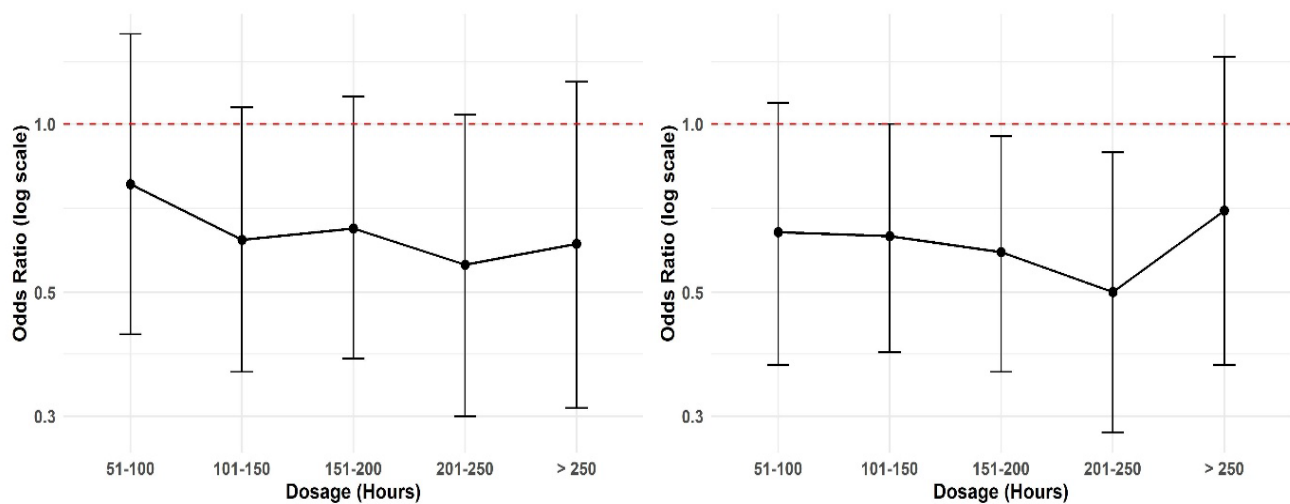
Variables	General Reoffending				Serious Reoffending			
	B	Odds Ratio	95% CI	<i>p</i>	B	Odds Ratio	95% CI	<i>p</i>
Dosage	-.002	0.98	[.99, 1.00]	.04	-.001	0.99	[.99, 1.00]	.14
Age	.02	1.02	[1.0, 1.03]	.01	.01	1.01	[.99, 1.02]	.13
Aboriginal Status	.04	1.04	[.81, 1.35]	.74	-.21	0.81	[.63, 1.03]	.09
Custody TRAS Score	3.53	34.18	[11.80, 99.07]	<.001	3.42	30.78	[11.22, 84.38]	<.001
Months in Custody	-.004	1	[1.00, 1.00]	.002	-.004	1	[.99, 1.00]	.009



**Figure 1.** Probability of general and serious reoffending across dosage delivered.

**Table 3.** Logistic regression modelling of dosage categories and reoffending outcomes

Variables	General Reoffending				Serious Reoffending			
	B	Odds Ratio	95% CI	p	B	Odds Ratio	95% CI	p
Dosage category								
51 - 100 hours	-.24	0.78	[.42, 1.45]	.43	-.45	0.64	[.37, 1.09]	.10
101 - 150 hours	-.47	0.62	[.36, 1.07]	.08	-.47	0.63	[.39, 1.00]	.04
151 - 200 hours	-.43	0.65	[.38, 1.12]	.12	-.53	0.59	[.36, .95]	.03
201 - 250 hours	-.58	0.56	[.30, 1.04]	.05	-.70	0.50	[.28, .89]	.01
> 250 hours	-.49	0.61	[.31, 1.19]	.15	-.35	0.70	[.37, 1.32]	.27
Age	.02	1.02	[1.0, 1.03]	.01	.01	1.01	[.99, 1.02]	.11
Aboriginal Status	.03	1.03	[.80, 1.33]	.82	-.21	0.81	[.63, 1.04]	.10
Custody TRAS Score	3.59	36.22	[12.5, 104.00]	<.001	3.47	32.15	[11.71, 88.27]	<.001
Months in Custody	-.004	1.00	[.99, 1.00]	<.001	-.005	1.00	[.99, 1.00]	.001

**Figure 2.** Odds ratios for general (left) and serious reoffending (right) across dosage categories for the full cohort.

## Relationship between dosage categories and reoffending as a function of reoffending risk

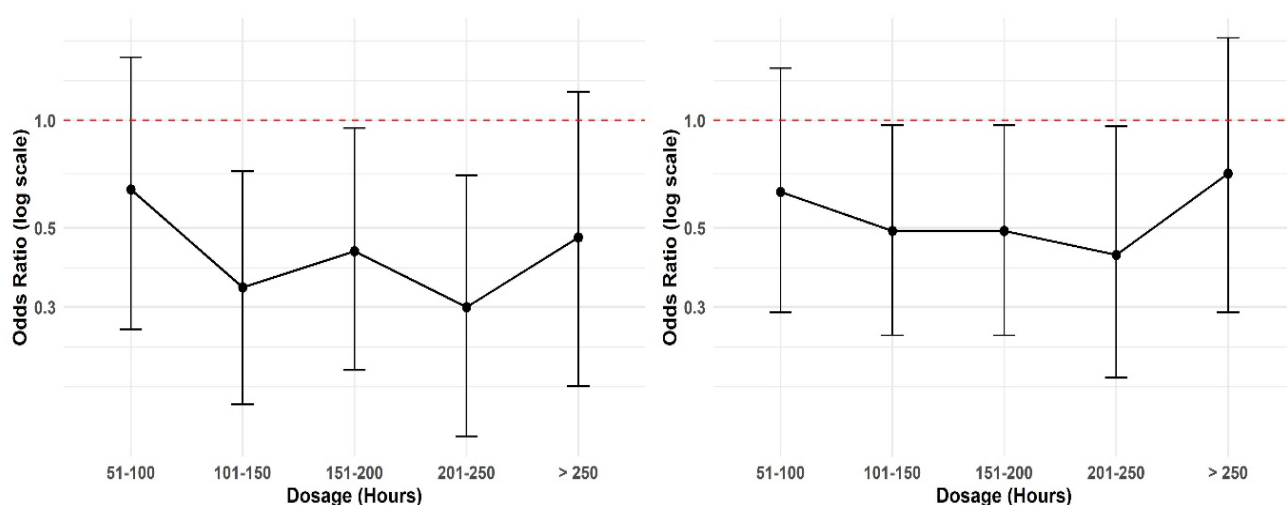
Tables 4 and 5 present the results of logistic models examining the dose-response relationship for individuals with an estimated general reoffending risk between 35% and 52% (TRAS-1 group) and for individuals with general reoffending risk of 52% or higher within 2 years post-release (TRAS-2 group), respectively.

### TRAS-1 (35%-52% recidivism risk)

The left panel of Figure 3 shows that the odds of general reoffending for individuals in the TRAS-1 group decreased across all dosage categories compared to those in the 0-50 hours category. The odds of general reoffending decreased until 101-150 hours, then fluctuated before increasing again for individuals who received more than 250 hours of intervention. Receiving 101-150 hours, 151-200 hours and 201-250 hours of intervention were associated with 66%, 57% and 70% reduction in odds of general reoffending, respectively, compared to 0-50 hours (Table 4).

**Table 4.** Logistic regression modelling of dosage categories and reoffending outcomes for the 'TRAS-1' group.

Variables	General Reoffending				Serious Reoffending			
	B	Odds Ratio	95% CI	p	B	Odds Ratio	95% CI	p
Dosage category								
51 - 100 hours	-0.45	0.64	[.26, 1.5]	.31	-0.46	0.63	[.29, 1.36]	.24
101 - 150 hours	-1.09	0.34	[.16, .72]	.005	-0.71	0.49	[.25, .97]	.03
151 - 200 hours	-0.83	0.43	[.20, .95]	.03	-0.71	0.49	[.25, .97]	.04
201 - 250 hours	-1.21	0.30	[.13, .70]	.006	-0.86	0.42	[.19, .96]	.04
> 250 hours	-0.76	0.47	[.18, 1.20]	.11	-0.34	0.71	[.29, 1.74]	.45
Age	0.03	1.03	[1.0, 1.00]	.01	0.02	1.02	[.99, 1.03]	.15
Aboriginal Status	0.08	1.09	[.75, 1.50]	.65	-0.16	0.85	[.58, 1.25]	.41
Months in Custody	-0.004	1.00	[.99, 1.00]	.004	-0.004	1.00	[.99, 1.00]	.02



**Figure 3.** Odds ratios for general (left) and serious reoffending (right) across dosage categories for the 'TRAS-1' group.

The relationship between dosage and likelihood of serious reoffending also showed that reoffending decreased in all dosage categories compared to 0-50 hours. After 101-150 hours, the reduction remained stable up to 250 hours, but increased for those who received more than 250 hours (see Figure 3, right panel). However, individuals who received 101-150, 151-200, and 201-250 hours exhibited significantly lower odds of serious reoffending (51%, 51%, and 58%, respectively) compared to those who received 0-50 hours (see Table 4).

We also found no significant differences in odds of serious reoffending between 101-150 hours

and 151-200 hours ( $B = -.008$ ,  $OR = .99$ , 95% CI [.63, 1.55],  $p = .97$ ), 201-250 hours ( $B = -.15$ ,  $OR = .85$ , 95% CI [.45, 1.61],  $p = .31$ ), and those who received more than 250 hours ( $B = .36$ ,  $OR = 1.43$ , 95% CI [.70, 2.93],  $p = .31$ ). Similar to the full cohort, these comparisons indicate a threshold at 101-150 hours for individuals with an estimated reoffending risk of 35% to 52%, after which the intervention effects plateau. The pattern of results may also suggest overdosage when dosage exceeds 250 hours.

## TRAS-2 (52%+ recidivism risk)

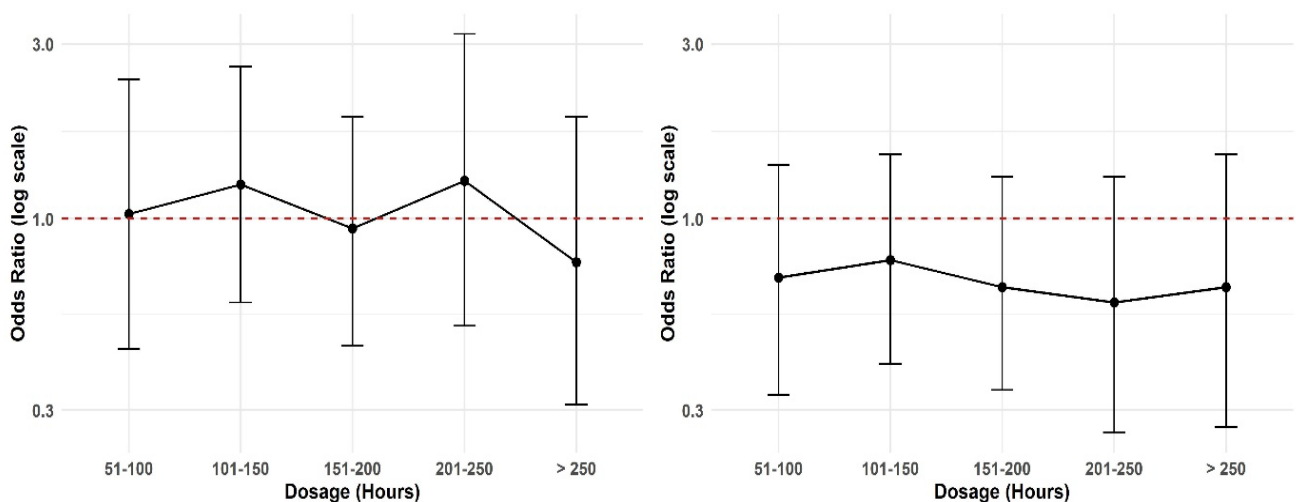
The overall pattern of associations between the dosage categories and reoffending outcomes for individuals in the TRAS-2 risk group differed from that of individuals in the TRAS-1 group. Although there were indications that the odds of general reoffending for specific dosage categories were higher than those who received 0-50 hours, the logistic regression modelling showed that these relationships fluctuated and did not differ

significantly from those who received 0-50 hours of intervention dosage (see Table 5).

The odds of serious reoffending were lower for all dosage categories compared to 0-50 hours category (see Figure 4, right panel), with a gradual reduction observed as dosage increased. However, none of the relationships between dosage categories and odds of serious reoffending were significantly different from 0-50 hours (see Table 5).

**Table 5.** Logistic regression modelling of dosage categories and reoffending outcomes for the 'TRAS-2' group.

Variables	General Reoffending				Serious Reoffending			
	B	Odds Ratio	95% CI	p	B	Odds Ratio	95% CI	p
Dosage category								
51 - 100 hours	0.03	1.03	[.44, 2.40]	.95	-0.37	0.69	[.33, 1.45]	.33
101 - 150 hours	0.22	1.24	[.59, 2.60]	.56	-0.26	0.77	[.40, 1.47]	.43
151 - 200 hours	-0.06	0.94	[.45, 1.90]	.86	-0.43	0.65	[.34, 1.26]	.20
201 - 250 hours	0.24	1.27	[.51, 3.20]	.60	-0.53	0.59	[.26, 1.33]	.20
> 250 hours	-0.27	0.76	[.31, 1.90]	.55	-0.43	0.65	[.27, 1.55]	.33
Age	0.01	1.01	[.98, 1.03]	.45	0.00	1.00	[.98, 1.02]	.79
Aboriginal Status	0.09	1.09	[.76, 1.56]	.62	-0.13	0.88	[.63, 1.20]	.41
Months in Custody	-0.004	1.00	[.70, 1.00]	.01	-0.01	1.00	[.99, 1.00]	.01



**Figure 4.** Odds ratios for general (left) and serious reoffending (right) across dosage categories for the 'TRAS-2' group.

---

## DISCUSSION

---

The current study explored the relationship between the intensity of intervention dosage and reoffending outcomes. Specifically, we aimed to identify dosage thresholds associated with measurable changes in reoffending, explore signs of under- and overdosage, and assess whether dose-response relationships varied by individuals' reoffending risk. This study examined dosage data from individuals who completed their allocated interventions under Corrective Services NSW's IP model, which is designed to provide higher risk individuals with a pathway of programs and services that target their criminogenic and non-criminogenic needs.

When intervention dosage was treated as a continuous variable, we found evidence of a linear dose-response relationship, where increasing dosage was associated with a modest, albeit statistically significant reduction in general reoffending. This finding is consistent with prior studies, which found that increasing dosage for those with higher risk was associated with lower odds of reoffending (Lipsey et al., 2007; Makarios et al., 2014). Increasing dosage was, however, not associated with differences in serious reoffending rates.

To explore potential non-linear effects (Makarios et al., 2014; Sperber et al., 2013), we further analysed the relationship between categories of dosage (in 50-hour increments) and reoffending. The results revealed non-linear patterns of dose-response relationships. Increasing dosage across categories from 101 to 250 hours was associated with marginal reductions in general reoffending and significant reductions in serious reoffending.

Notably, these effects appeared to plateau at 101-150 hours where we found no significant differences in reoffending outcomes for those who received 101-150, 151-200, and 201-250 hours of dosage. These results may suggest that a dosage of 101-150 hours is the threshold for effective intervention, at which a non-linear dose-response relationship begins to emerge.

Previous research supports these findings, demonstrating a parabolic dose-response relationship indicating that a maximum of 150 hours may effectively reduce reoffending among individuals serving community sentences (Makarios et al., 2014). Establishing dosage thresholds could enable correctional programmers to design effective programs and allocate resources to tailor services within the constraints of sentence length and criminogenic needs. For example, the finding that 101 to 150 hours of dosage is as effective as higher ranges (151-200 or 201-250 hours) in reducing serious reoffending could be especially relevant for short-sentenced individuals. Given that a significant proportion of people serve less than two years in custody in NSW (35%; Smith & Tang, 2025), this dosage amount may be both feasible and impactful within sentence length and administrative constraints.

We found that while individuals across most of the dosage categories tended to have lower odds of reoffending, outcomes for individuals who received between 51 and 100 hours of dosage or those who received more than 250 hours were not significantly different from those who received 0-50 hours. This suggests that receiving less than 100 hours may not be adequate to produce measurable changes in reoffending outcomes for those at higher risk of reoffending

(underdosage), and dosage exceeding 250 hours appeared to show diminishing intervention benefits, indicating potential overdosage. Although reoffending outcomes for individuals who received 51-100 hours did not significantly differ from those with 0-50 hours, this does not necessarily imply that these dosage levels were ineffective. It is possible that there is a benefit in receiving 51-100 hours, although this is similar to the benefit derived from receiving slightly less dosage in the 0-50 hours bandwidth, which served as the reference group in our analyses. We opted for this design as opposed to a true no-dosage comparison group to improve equivalence across groups in terms of individual's motivation and ability to complete intervention pathways.

This study found that those who received more than 250 hours showed signs of overdosage, which is in contrast to Bourgon and Armstrong's (2005) recommendation of more than 300 hours of dosage to derive benefit from custodial based interventions. Differences in the composition of interventions included in dosage calculations may account for discrepancies between studies. While earlier studies have primarily focused on dosage from CBT-based criminogenic interventions (Bourgon & Armstrong, 2005; Makarios et al., 2014; Sperber et al., 2013), the current study's definition of dosage under the IP model encompasses a broader array of programs and services, including education, reintegration, and vocational training. Education and reintegration services, in particular, are critical for addressing the multifaceted needs of higher risk individuals (Andrews et al., 2006; Berghuis et al., 2018), and Hsieh et al. (2022) found incremental improvements in reoffending outcomes when individuals engage in multiple

interventions compared to only a single intervention. Given that our calculation of dosage represents multiple interventions, the findings may be indicative of cumulative or synergistic effects of diverse interventions in dose-response effects; however, the specific mechanisms underlying these effects remain unclear. We are currently engaged in additional studies to further investigate the relative contributions of individual and combined interventions to reoffending outcomes.

We also examined whether dose-response relationships varied by reoffending risk level. Among individuals with a moderate band of 35%-52% risk of reoffending (TRAS-1 group), the same patterns described above were observed: receiving between 101 and 250 hours of multiple interventions are beneficial in reducing general and serious reoffending. We also observed large effect sizes among individuals in this group across distinct dosage categories within this range. The large effect sizes could be attributed in part to the potential interactive or cumulative effects of multiple interventions, which may not be evident when evaluating a single intervention in isolation, as well as to the smaller sample of individuals receiving greater amount of dosage.

In contrast, for those with a risk level above 52% (TRAS-2 group), no significant associations were found between dosage and reoffending outcomes. Those at the highest risk may face additional barriers that limit the effectiveness of interventions as they are currently constructed or delivered through the model, such as more complex needs or responsivity issues (Bonta & Andrews, 2016; Cohen & Whetzel, 2014). For individuals at very high risk of reoffending, the dose-response relationship may vary, with even

---

250 or more hours of dosage potentially insufficient to effect behavioural change. It is also possible that these individuals may require alternative approaches, such as more tailored and holistic interventions. This also has broader implications for existing case management strategies, which currently use a 35% threshold to identify higher risk individuals. A more tiered assessment to identify those with particularly high risk or complex presentation may be necessary to ensure that intervention intensity and case management strategies are appropriately aligned to individual profiles.

## Limitations

This study is the first to examine the impact of intervention dosage on reoffending outcomes within an Australian custodial context, contributing valuable local evidence to a field dominated by international research. However, generalisability to other jurisdictions and community-based corrections contexts remains uncertain.

Additionally, the high proportion of individuals with short sentences in our sample may limit the applicability of findings to longer-term custodial populations. Although time in custody was statistically adjusted in the regression models, this remains a contextual limitation. Also, given that we focused on individuals with an estimated general reoffending risk of 35% or higher, our findings might not be generalisable to other reoffending risk bands (lower reoffending risk).

A key strength of the research design was its focus on examining dose-response relationships only among individuals who completed their allocated intervention pathways. This approach

improved group equivalence in terms of motivation and ability to complete interventions, while also reducing confounding effects associated with dosage variability due to instances of intervention disengagement or attrition. However, we acknowledge that variation in received dosage can be influenced by unobserved factors within intervention pathways. For example, some individuals may be motivated to complete shorter programs but not the longer ones, or may complete mandated intensive behaviour change programs but not voluntary non-intensive or education programs which serve to accumulate greater dosage. While the setting of the intervention pathways model provided a valuable opportunity to study naturalistic variation in dosage under field settings, the findings and implications would be supported by more experimental manipulations of intervention intensity.

## Conclusions

This study leveraged data from Corrective Services NSW's IP model to examine the relationship between intervention dosage and reoffending outcomes among higher risk individuals in NSW prisons. While higher dosage was generally associated with lower rates of reoffending, dose-response relationships were non-linear and varied by dosage category and individual reoffending risk level. Specifically, delivering between 101 and 250 hours of intervention was associated with significant reductions in serious reoffending with diminishing returns observed below and beyond this range. Importantly, additional analyses indicated that these patterns were observed for individuals with moderately high risk but not for those with very high risk of recidivism. These

findings contribute to the limited empirical literature on dosage effects in custodial correctional settings and provide practical insights for the design of correctional programs and resource allocation. This study also underscores the importance of tailoring intervention intensity to individual risk profiles. Future research should further explore the mechanisms underlying these effects and how dosage and other intervention characteristics may be tailored to optimise outcomes across diverse risk profiles.

## REFERENCES

- Andrews, D. A., & Bonta, J. (2014). *The psychology of criminal conduct*. Routledge.  
<https://doi.org/10.4324/9781315677187>
- Andrews, D. A., Bonta, J., & Wormith, J. S. (2006). The recent past and near future of risk and/or need assessment. *Crime & Delinquency*, 52(1), 7–27.  
<https://doi.org/10.1177/001112870528175>
- Andrews, D. A., & Dowden, C. (2006). Risk principle of case classification in correctional treatment: A meta-analytic investigation. *International Journal of Offender Therapy and Comparative Criminology*, 50(1), 88–100.  
<https://doi.org/10.1177/0306624X05282556>
- Beaudry, G., Yu, R., Perry, A. E., & Fazel, S. (2021). Effectiveness of psychological interventions in prison to reduce recidivism: A systematic review and meta-analysis of randomised controlled trials. *The Lancet Psychiatry*, 8(9), 759–773. [10.1016/S2215-0366\(21\)00170-X](https://doi.org/10.1016/S2215-0366(21)00170-X)
- Berghuis, M. (2018). Reentry programs for adult male offender recidivism and reintegration: A systematic review and meta-analysis. *International Journal of Offender Therapy and Comparative Criminology*, 62(14), 4655–4676.  
<https://doi.org/10.1177/0306624X18778448>
- Bonta, J., & Andrews, D. A. (2016). *The psychology of criminal conduct*. Taylor & Francis.  
<https://doi.org/10.4324/9781315677187>
- Bourgon, G., & Armstrong, B. (2005). Transferring the principles of effective treatment into a “real world” prison setting. *Criminal Justice and Behaviour*, 32(1), 3–25.  
<https://doi.org/10.1177/0093854804270618>
- Bower, M., Howard, M. V., Stapinski, L. A., Doyle, M. F., Newton, N. C., & Barrett, E. L. (2023). The profile of people entering the ‘EQUIPS’ offender treatment programs in New South Wales’. *Current Issues in Criminal Justice*, 1–15.  
<https://doi.org/10.1080/10345329.2023.2253721>
- Blaine, B. E. (2018). Winsorizing. *The SAGE encyclopedia of educational research, measurement, and evaluation*, 1817.  
<https://dx.doi.org/10.4135/9781506326139.n747>
- Cohen, T. H., & Whetzel, J. (2014). The neglected R-Responsivity and the federal offender. *Federal Probation*, 78, 11.  
<https://www.uscourts.gov/file/22773/download>
- Duwe, G. (2018). The effects of the timing and dosage of correctional programming on recidivism. *Journal of Offender Rehabilitation*, 57(3–4), 256–271.  
<https://doi.org/10.1080/10509674.2017.1401025>
- Frölich, M. (2004). Programme evaluation with multiple treatments. *Journal of Economic Surveys*, 18(2), 181–224. <https://doi.org/10.1111/j.0950-0804.2004.00001.x>
- Hsieh, M. L., Chen, K. J., Choi, P. S., & Hamilton, Z. K. (2022). Treatment combinations: The joint effects of multiple evidence-based interventions on recidivism reduction. *Criminal Justice and Behavior*, 49(6), 911–929.  
<https://doi.org/10.1177/00938548211052584>
- Jiang, H., Kulkarni, P. M., Mallinckrodt, C. H., Shurzinske, L., Molenberghs, G., & Lipkovich, I. (2017). Covariate adjustment for logistic regression analysis of binary clinical trial data. *Statistics in Biopharmaceutical Research*, 9(1), 126–134.  
<https://doi.org/10.1080/19466315.2016.1234973>
- Koehler, J. A., Lösel, F., Akoensi, T. D., & Humphreys, D. K. (2013). A systematic review and meta-analysis on the effects of young offender treatment programs in Europe. *Journal of Experimental Criminology*, 9, 19–43.  
<https://doi.org/10.1007/s11292-012-9159-7>
- Latessa, E. J., Lovins, L. B., & Smith, P. (2010). *Follow-up evaluation of Ohio’s community based correctional facility and halfway house programs—Outcome study*. Cincinnati: University of Cincinnati.
- Lipsey, M. W., & Cullen, F. T. (2007). The effectiveness of correctional rehabilitation: A review of systematic reviews. *Annual Review of Law and Social Science*, 3(1), 297–320.  
<https://doi.org/10.1146/annurev.lawsocsci.3.081806.112833>
- Lutz, M., Zani, D., Fritz, M., Dudeck, M., & Franke, I. (2022). A review and comparative analysis of the risk-needs-responsivity, good lives, and recovery models in forensic

- 
- psychiatric treatment. *Frontiers in Psychiatry*, 13, 988905. <https://doi.org/10.3389/fpsy.2022.988905>
- Mahajan, Y., Sarker, A., & Howard, M. (2024a). *Examination of treatment dosage delivered through the Intervention Pathways Model. Research Bulletin no. 64*. Sydney: Corrections Research Evaluation and Statistics, Corrective Services New South Wales.
- Mahajan, Y., Sarker, A., & Howard, M. (2024b). *Evaluation of throughput and participation outcomes for the Intervention Pathways model. Research Brief no 16*. Sydney: Corrections Research Evaluation and Statistics, Corrective Services New South Wales.
- Makarios, M., Sperber, K. G., & Latessa, E. J. (2014). Treatment dosage and the risk principle: A refinement and extension. *Journal of Offender Rehabilitation*, 53(5), 334-350. <https://doi.org/10.1080/10509674.2014.922157>
- O'Donnell, I. (2020). *An evidence review of recidivism and policy responses*. Department of Justice & Equality, Dublin, 2-102.
- Peters, D. J., Hochstetler, A., DeLisi, M., & Kuo, H. J. (2015). Parolee recidivism and successful treatment completion: Comparing hazard models across propensity methods. *Journal of Quantitative Criminology*, 31(1), 149-181. <https://doi.org/10.1007/s10940-014-9229-2>
- Raudino, A., Corben, S., Galouzis, J., Mahajan, Y., & Howard, M. (2019). *The Custody Triage Risk Assessment Scale (Custody TRAS): An updated statistical model for predicting risk of return to custody. Research Bulletin no. 41*. Sydney: Corrections Research Evaluation and Statistics, Corrective Services New South Wales.
- Simourd, D. J., & Olver, M. (2019). Prescribed correctional treatment dosage: Cautions, commentary, and future directions. *Journal of Offender Rehabilitation*, 58(2), 75-91. <https://doi.org/10.1080/10509674.2018.1562503>
- Smith, C., & Tang, H. (2025). NSW Inmate Census 2024: Summary of Characteristics. Corrections Research Evaluation and Statistics, Corrective Services NSW.
- Sperber, K. G., Latessa, E. J., & Makarios, M. D. (2013). Examining the interaction between level of risk and dosage of treatment. *Criminal Justice and Behavior*, 40(3), 338-348. <https://doi.org/10.1177/00938548124679>
- Sperber, K. G., & Lowenkamp, C. T. (2017). Dosage is more than just counting program hours: The importance of role-playing in treatment outcomes. *Journal of Offender Rehabilitation*, 56(7), 433-451. <https://doi.org/10.1080/10509674.2017.1359222>
- Swartz, J. A., Lurigio, A. J., & Slomka, S. A. (1996). The impact of IMPACT: An assessment of the effectiveness of a jail-based treatment program. *Crime & Delinquency*, 42(4), 553-573. <https://doi.org/10.1177/00112879604200400>

## Other CRES Research Titles

Nov 2025	Exploring perceptions of correctional climate among people on community supervision in New South Wales	June 2024	Full body x-ray scanners at NSW correctional centres: Staff and inmate perspectives
Oct 2025	Environmental influences on perceptions of correctional climate: A multilevel modelling analysis	April 2024	Evaluation of throughput and participation outcomes for the Intervention Pathways model
Sept 25	Evaluation of the Practice Guide for Intervention (PGI): Assessments of quality assurance and supervisee outcomes	March 2024	Evaluation of the Compulsory Drug Treatment Program: Within-treatment change
Aug 2025	Identification of criminogenic needs using the PARRCC assessment tool	Feb 2024	Examination of treatment dosage delivered through the Intervention Pathways Model
July 2025	Profiles of criminogenic need among Aboriginal and non-Aboriginal men and women in prison	Dec 2023	Assessment and experience of prison climate in NSW correctional centres
June 2025	Conducting survey research using inmate digital tablets: Are respondents representative of the inmate population?	Dec 2023	Five Minute Intervention (FMI) skills acquisition by correctional staff: The role of manager buy-in
Dec 2024	Evaluation of the Practice Guide for Intervention (PGI): Triangulating perceptions of dual role relationships and their associations with staff practice and supervisee outcomes	Dec 2023	Dynamics of wellbeing and needs satisfaction among people in prison
Nov 2024	Exploring perceptions of correctional climate among people in prison in New South Wales	Dec 2023	Empirical review of the Pathways to Employment (P2E) pilot for women in prison
Nov 2024	Exploring perceptions of organisational fairness and safety attitudes among correctional staff in NSW	Dec 2023	Conducting survey research using inmate digital tablets: Lessons learned from research conducted in NSW correctional centres
Sept 2024	Implementing digital technologies in Prison: Inmates' ongoing experiences of tablet access and connections with family and friends	Oct 2023	Assessing the impact of Five Minute Interventions (FMI) training on behavioural indicators of correctional centre safety and order: An interrupted time series analysis
Sept 2024	Drivers of program participation in NSW correctional centres: A trend analysis of digital tablets and Five Minute Interventions (FMI)	Oct 2023	Impacts of digital tablets on trends in correctional centre safety and order: A controlled interrupted time series study
June 2024	Full body x-ray scanners at NSW correctional centres: Scanner activity, contraband, and behavioural outcomes		



Research Bulletin No.69  
ISSN 2207 0850  
© Corrective Services NSW

Corrections Research, Evaluation & Statistics  
Delivery, Performance & Culture  
Locked Bag 5000  
Parramatta NSW Australia 2124  
Email:  
[research.enquiries@correctiveservices.nsw.gov.au](mailto:research.enquiries@correctiveservices.nsw.gov.au)