Ministry of Justice

Impact Evaluation of the Acquisitive Crime Electronic Monitoring Project: 12 month+ cohort

Scarlett Sinclair and David McAlonan

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1. Summary

1.1 Overview of methodology

The impact of the Acquisitive Crime (AC) Project's 12 month+ cohort was primarily assessed based on proven reoffending behaviour within 12 months of release from prison, which was estimated by the Department's Justice Data Lab. Separately, there was also an assessment of the intermediate outcomes of recall to prison, the average number of formal warnings for licence breach and the average probationary compliance rate within 12 months of release that was undertaken by the research team.

Both sets of analyses were based on treatment and comparison groups of AC eligible prison leavers, where the latter groups were derived using Propensity Score Matching of prison leavers released up to June 2022 for the reoffending analysis and up to September 2023 for the other outcomes.

An indicative estimate of the effect on police activity was based on a difference-in-differences methodology of the number of adult arrests for theft and robbery between participating and non-participating police force areas between 2021/22 and 2023/24.

It is important to note that most of the data were based on management information that were not intended for research purposes, which was subject to input errors or missing values. In addition, a proxy had to be employed so as to disaggregate the AC treatment group into their constituent 12 month+ and 3-12 month cohorts. Furthermore, the results of the proven reoffending analysis were limited to male prison leavers, so they may lack generalisability to the female prison leavers enrolled in the project.

1.2 Key findings

The impact evaluation of the AC Project's 12 month+ cohort found:

- Among AC order starts between go-live in April 2021 up to the end of June 2022, the male prison leavers enrolled in the project were associated with a seven

percentage point decline in the rate of reoffending within 12 months of release (from 33.2% to 26.2%). The average number of reoffences per offender also declined by 0.35 (from 1.04 to 0.69) over the same time period. Both of these results were statistically significant.

- To the extent that these results can be generalised to the cohort's approximate 3,360 AC orders involving an EM tag installation that completed between 2021/22 and 2023/24, it is inferred that the intervention resulted in roughly 1,200 fewer proven reoffences (which were mostly theft and summary offence types) and around 235 fewer proven reoffenders.
- There was no evidence of a statistically significant change in the number of days to the first proven reoffence among the cohort following release from prison.
- Among the AC order starts up to September 2023 that resulted in an EM tag installation, there was no evidence of a statistically significant change in the likelihood of recall to prison, the number of licence breaches or the overall probationary compliance rate within 12 months of release.
- Based on "should take" timings of various EM-specific activities, it was estimated that HMPPS staff expended in the region of 140,000 work hours on delivering the AC orders involving a tag installation that completed up to 2023/24. Most of this time commitment was due to the need regularly to check the AC Portal.
- There was evidence that the provision of proximity alerts to participating police forces through the project's crime mapping facility could have led to some 16,000 fewer adult arrests for reported acquisitive offences up to 2023/24. In short, the intervention likely helped to make this group of criminal investigations more efficient than otherwise through the earlier dismissal of suspects.
- It was indicatively estimated that the police forces participating in the AC Project's 12 month+ cohort expended roughly 7,000 work hours on dealing with the proximity alerts generated up to 2023/24.
- The available management information indicated that under one per cent of acquisitive crime searches resulted in a proximity alert to the police to support a criminal investigation, of which almost one per cent was recorded by the police as having a subsequent summons or charge. This was equivalent to around 240

summonses/charges up to the end of 2024, of which about 160 had resulted in a conviction, regardless of AC cohort.

- However, it is unknown what proportions of these prosecutions and convictions of reoffenders would have happened anyway, given the availability of other evidence presented in court. In other words, the use of proximity alerts did not result in a sizeable number of additional convictions up to the end of 2024, which represented under one per cent of all relevant adult convictions over the period for AC Project specific offence types.

1.3 Overall conclusion

The research findings provide evidence that this form of Electronic Monitoring was associated with a reduction in proven reoffending with respect to the AC Project's 12 month+ cohort of male prison leavers in the year following release.

In contrast, there was no detectable effect of the project on the outcomes of recall to prison, licence breach or overall probationary compliance.

The supply of information to the police regarding AC location monitored individuals in the vicinity of reported acquisitive offences appeared to reduce the number of adult arrests made, and it likely helped to make these types of criminal investigations more efficient than otherwise. However, the impact of the project on the relevant number of prosecutions and convictions was very limited.

Notwithstanding the conclusion that the AC Project's 12 month+ cohort was associated with a positive impact on proven reoffending within 12 months of release, it does not necessarily follow that there was also a positive net benefit to society. This assessment of overall value for money will be the product of a separate economic evaluation that examines the balance of costs and benefits arising from this intervention.

2. Background

This report sets out the impact evaluation findings from the AC Project's 12 month+ cohort.

It follows the process evaluations of the project's 12 month+ and 3-12 month cohorts (Yates, McAlonan & Omoruyi, 2025).[1]

2.1 AC Project: 12 month+ cohort

Individuals who commit acquisitive crimes (i.e., theft and robbery) tend to have above average 12 month reoffending rates of all principal offence types[2] in England and Wales. For instance, 50 per cent of adults who had a CJS disposal for a theft offence (including burglary) during 2021/22 reoffended within a year, which was twice as high as for all adults that year.[3]

These offence types also have worse detection rates – e.g., in 2022/23 the police were unable to identify a suspect in 74 per cent of all recorded theft outcomes and 49 per cent of all recorded robbery outcomes, compared to 39 per cent of all recorded crime.[4,5]

The compulsory AC Project started on 12 April 2021 in six Police Force Areas[6] (PFAs) of England and Wales, which was extended to a total of 19 PFAs on 29 September 2021.[7] It was based on the Global Positioning System (GPS) form of Electronic Monitoring (EM).

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1 https://assets.publishing.service.gov.uk/media/67bdaa1121d07694be8d7688/process-evaluation-acquisitive-crime-electronic-monitoring-project-12-month-cohort.pdf

2 A principal offence is the most serious offence type committed.

3 Table A4a, https://www.gov.uk/government/statistics/proven-reoffending-statistics-january-to-march-2022. With regard to non-custodial sentences, this 12 month time period for reoffending starts on the date of court conviction or the date of receipt for a caution, reprimand or final warning. With respect to custodial sentences, the 12 month time period starts on the date of release from prison.

4 Table 1.2, https://www.gov.uk/government/statistics/crime-outcomes-in-england-and-wales-2023-to-2024

5 Estimates were similar for 2023/24.

6 Compulsory Electronic Monitoring Licence Condition Order 2021 (https://www.legislation.gov.uk/uksi/2021/330/contents)

7 Compulsory Electronic Monitoring Licence Condition (Amendment) Order 2021 (https://www.legislation.gov.uk/uksi/2021/999/contents/made)

Eligible prison leavers were automatically enrolled in the AC Project for a maximum of 12 months on release. Those eligible for mandatory enrolment in the AC Project were prison leavers released on licence who had been serving a standard determinate sentence of 12 months or more (the "12 month+ cohort") for specific types of theft or robbery, where this was the longest or joint longest custodial sentence imposed.[8]

In addition to enrolees' lack of discretion regarding participation, these individuals were not routinely notified that they were part of a pilot study whose outcomes would be evaluated by the MoJ. In short, there was a limited risk of systematic "strategic behaviour" by participants.

The project provided location monitoring information to probation practitioners and "proximity alerts" to participating police forces about enrolled individuals who were in the vicinity of reported acquisitive offences.[9] The policy goals of this compulsory intervention were to reduce reoffending and to provide greater public protection with respect to acquisitive offenders released from prison.

2.2 Theory of change

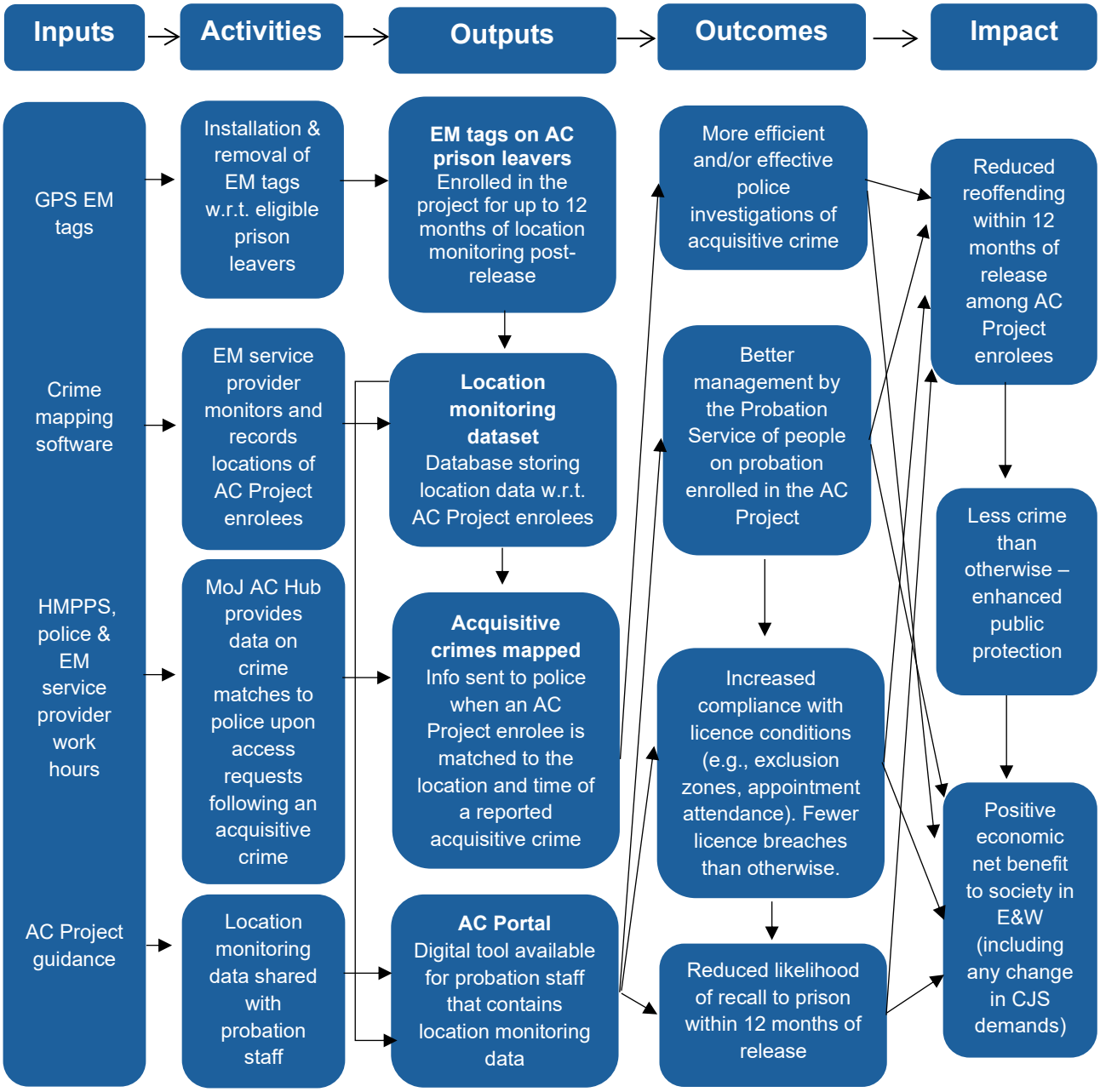
Figure 1 sets out a "theory of change" for the AC Project. This is an illustration of how the mandatory GPS-based location monitoring of prison leavers enrolled in the project was expected to achieve its intended outcomes, including the underlying assumptions and risks that would govern success.

[8] The custodial threshold for eligible acquisitive offences within the AC Project was lowered to at least 90 days in late October 2022. This additional cohort is not the subject of the current impact evaluation.

[9] The specific offence types were: aggravated burglary; robbery; burglary in a dwelling; burglary in a building other than a dwelling; theft from person; theft of a motor vehicle; and theft from a motor vehicle.

Figure 1: AC Project theory of change

CONTEXT: Adults who commit acquisitive crime tend to have higher than average rates of reoffending and higher than average rates of police investigations ending without any suspect being identified. It is proposed that the use of compulsory location monitoring for up to 12 months, based on GPS EM tags, among this group of prison leavers released on licence will result in less reoffending and thus an overall economic net benefit to society.



ASSUMPTIONS

- Prison leavers who are enrolled in the AC Project make themselves available for EM tag installation, regularly charge their tag batteries and do not disable the devices that they are obliged to wear.
- AC Project enrolees understand the implications of their GPS location monitoring such that they know their movements are recorded and made available to the Probation Service or, if necessary, the police. AC enrolees change their behaviour positively as a result.
- Probation practitioners actively use the location monitoring information generated to improve their management of AC enrolees in the community.
- The crime mapping process accurately detects an AC enrolee who is in the vicinity of an acquisitive crime. Police act on that information.
- The GPS EM tags perform as required on a continuous basis.

RISKS

- The probationary management of prison leavers enrolled in the AC Project becomes onerous and much more time-consuming than otherwise.
- AC enrolees experience higher rates of recall and/or reduced overall compliance with licence conditions because they have more opportunities to "fail".
- AC enrolees experience social stigma from having to wear an EM tag and/or react against the increased surveillance of their everyday movements.
- Any behavioural benefits on the part of prison leavers enrolled in the AC Project do not exist or they do not persist beyond the period of wearing the EM tag.
- GPS "drift" negatively impacts crime mapping and/or the EM tag malfunctions.
- It is the physical GPS tagging and/or probationary supervision informed by location monitoring that affects AC enrolees' behaviour, while the existence of crime mapping has little or no direct effect.
- The total costs of the AC Project exceed its economic benefits over time.

Three essential causal pathways expected to deliver the desired behavioural change were therefore identified:

A. Probation practitioners utilise the location monitoring data to inform their supervision and risk management of people on probation enrolled in the AC Project.
B. The increased surveillance and perceived likelihood of detection encourage greater probationary compliance in general and deter reoffending among AC monitored individuals.
C. Identified matches of acquisitive crime with the locations of AC monitored individuals provide information that enhances police investigations.

Selection of police force areas

In broad terms, the 19 police forces that began participating in the AC Project during 2021 were invited to do so by the MoJ. The invitations were essentially based on the criterion of

having a reasonably representative cross-section of police forces – primarily larger and smaller sized, more and less urban and geographically distributed – alongside the availability of Integrated Offender Management[10] practices. Advice from HMPPS was also taken into account, given the possible impact on probation practitioners.

2.3 Literature review of GPS location monitoring

The empirical evidence assessing the effectiveness of EM on reoffending is mixed and relatively limited (e.g., Gies et al., 2013; Turner, Chamberlain, Janetta & Hess, 2015; Gies, Gainey & Healy, 2016; Hawkes, Sellbom & Gilmour, 2023).

It is notable that studies examining the impact of electronic monitoring often lack appropriate control groups, randomised control trials and robust sample sizes, which makes it difficult to form strong conclusions on effectiveness (Renzema & Mayo-Wilson, 2005). Indeed, the latest published meta-analysis found that there was considerable low to medium quality evidence throughout the published literature on EM generally (Belur et al., 2020).

Among the 18 studies included in their overall quantitative meta-analysis, Belur et al. (2020) concluded that there was no significant effect of GPS EM on reoffending (mean odds ratio = 1.17, CI: 0.79 – 1.75). Only two of the 18 studies involved the randomisation of subjects – i.e., Killias et al. (2010) and Lapham et al. (2007).

Conversely, in a more recent study conducted inside New Zealand, which reportedly has the highest use of EM per capita globally and which is mostly based on GPS, the authors found significant reductions in violent reoffending (odds ratio = 2.06, CI: 1.28 – 3.32) and non-violent reoffending (odds ratio = 1.92, CI: 1.37 – 2.69) among male prison leavers subject to GPS EM compared to their matched counterparts who were monitored differently over a 24 month period post-release (Hawkes et al., 2023).[11] However, there

[10] Integrated Offender Management (IOM) provides a way in which criminal justice agencies and other partners can share information and work more closely together to supervise groups of offenders in the community who are considered likely to reoffend. The AC Project's use of IOM is currently recommended, but not legally required, by participating police force areas.

[11] The study's treatment group contained a mixture of individuals who were and were not subject to GPS monitoring for the entire duration of the 24 month follow-up period.

was no statistically significant difference in respect of "administrative" reoffending (odds ratio = 0.83, CI: 0.53 – 1.30).[12]

In addition, there is evidence that offender type is associated with the effectiveness of EM. For instance, Belur et al. (2020) found there was a significant effect of EM on reoffending when considering studies which specifically analysed sex offenders (mean odds ratio = 2.41, CI: 1.66 – 3.49), whereas the impact on "high risk" offenders of reoffending was not significant (mean odds ratio = 1.03, CI: 0.54 – 2.10).[13] The authors also concluded that there was a significant effect of EM as an alternative to prison following conviction (mean odds ratio = 1.41, CI: 1.08 – 1.85), but not for pre-sentence (mean odds ratio = 0.88, CI: 0.52 – 1.48) and not for post-release from prison (mean odds ratio = 1.46, CI: 0.83 – 2.56).

Separately, there has been little research focusing specifically on acquisitive crime and EM, which may be surprising given that official statistics in England and Wales show that adults whose principal offence type was theft have the highest reoffending rate.[14] In some of the few studies regarding acquisitive crime, GPS EM has been combined with other interventions – e.g., support programmes which provide education interventions and counselling (Pearson, 2012). Where GPS location monitoring has been used alongside other requirements, attributing effectiveness to the EM element alone is challenging (Pearson, 2012; Belur et al., 2020).

More recent research by Bouffard and Butler (2024) looked specifically at the effect of EM on the success of supervision in the community. The authors found that people on probation in one American state were significantly less likely to complete their term of supervision when subject to GPS EM compared to no EM (difference = 19pp, Z = 7.24, $p<0.01$). There was a similar result of a significantly lower likelihood of completing supervision among those offenders who were subject to EM in general compared to no EM (difference = 10pp, Z = 5.86, $p<0.01$).

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[12] "Administrative" reoffences were defined as technical breaches of conditions of release from prison, which are criminal offences in New Zealand that can result in a further custodial sentence.

[13] In many of the studies examined there was no overall standard method to define "high risk". Risk is often assessed by the probation practitioners and therefore there may be some subjectivity between who is deemed high, medium and low risk. Factors used to assess risk can include index offence type, criminal record and type of victim.

[14] Table A4a, https://www.gov.uk/government/statistics/proven-reoffending-statistics-january-to-march-2022

This could be because the additional surveillance provided by GPS EM – and by EM more broadly – increased the ability to identify probationary violations and any reoffending, although the requirements of EM may also have increased the opportunities for failure on the part of people on probation. The causal mechanisms of EM may therefore work in different ways depending on the outcome in question.

In line with the overall conflicting quantitative research, qualitative studies have also found differing perceptions on the usefulness of GPS location monitoring. Interviews with police officers have suggested a generally positive perception of the effectiveness of GPS EM, whereas offenders' perceptions have been less consistent (Hudson & Jones, 2016; Bales et al., 2010). While some offenders believed that it enhanced their motivation to change and to desist from reoffending, others stated that the EM tag made no difference to their likelihood to commit crime (Hudson & Jones, 2016; Bales et al., 2010).

However, high rates of compliance with an individual's licence conditions have been reported even in those individuals who said they would reoffend following removal of the EM tag (Hucklesby, 2008; 2009). This suggests that, at least for the duration of the EM period, there is a perception it is effective.

Overall, the heterogeneous nature of EM and how it is employed in relation to different offender cohorts means that there is a need for further research to assess the impact of the various forms of EM and under what conditions.

2.4 Research questions

The goal of this impact evaluation is to answer the following research questions in relation to the AC Project's 12 month+ cohort:

- What was the effect on reoffending within 12 months of release from prison?
- What was the effect on the intermediate outcomes of recall to prison, licence breach and probationary compliance within 12 months of release?
- What was the effect of crime mapping on police investigations?

3. Methodology

3.1 Approach to quantification

An explanation of the ethics of the methodological approach are contained in Appendix K.

Eligibility criteria

The following list sets out the AC Project's eligibility criteria for mandatory enrolment:

- a prison leaver who was convicted of an in-scope acquisitive offence;[15]
- a standard determinate custodial sentence imposed for the in-scope acquisitive crime was the longest or joint longest given and for a minimum of 12 months; and
- the offender was sentenced as an adult.

The treatment group was defined as a prison leaver who was released on licence on or after 12 April 2021 to reside in one of the participating police force areas. In contrast, the comparison group was released into a non-participating police force area. The cut-off point for the reoffending analysis was June 2022, and for analysis of the other outcomes was September 2023.

Some members of each group were released from prison on Home Detention Curfew[16] (HDC), the presence of which was controlled for in the impact evaluation.

Reoffending impacts

Those prison leavers who were compulsorily enrolled in the AC Project between 12 April 2021 and 30 June 2022 formed the 12 month+ treatment group for the reoffending analysis. Other prison leavers who would have been enrolled in the AC project had they been released to live in a participating police force area formed the comparison group.

[15] See Appendix A for a list of the project's eligible offence types.

[16] HDC is a long-standing scheme that enables some types of prisoner in England and Wales to be released before their conditional release date. The prison leaver must adhere to an electronically monitored curfew inside their residence, which typically lasts for 12 hours per day. (See https://www.gov.uk/government/publications/home-detention-curfew for more information about HDC.)

Using data recorded on the Police National Computer[17] (PNC) and other data sources, the MoJ's Justice Data Lab[18] estimated the rate and average frequency of proven reoffending within 12 months of release among both groups of prison leavers. The associated reoffence mix and time to first reoffence was also estimated.

Members of the comparison group were matched to members of the treatment group using an established statistical technique called Propensity Score Matching (PSM).[19]

Following the application of PSM, the reoffending analysis dataset consisted of 500 male prison leavers in the treatment group and 1,208 male prison leavers in the comparison group. Females were excluded by the Justice Data Lab due to the small proportion of women enrolled in the AC project.

See Appendix B for more information about the use of PSM for the reoffending analysis.

HMPPS impacts

PSM was also conducted for the analysis of intermediate outcomes related to the Probation Service. This applied to a longer time series of observations than was possible for the 12 month proven reoffending analysis due to the necessary follow-up time to allow for a conviction.[20]

The prison leavers released between 12 April 2021 and 30 September 2023 plus their various recorded characteristics and criminogenic factors were obtained using the data recorded in P-NOMIS, nDelius and OASys.[21] This combined dataset was restricted to prison leavers who were either enrolled in the AC Project or would have been enrolled had

17 https://www.gov.uk/government/publications/code-of-practice-for-the-police-national-computer-and-the-law-enforcement-data-service/code-of-practice-for-the-police-national-computer-pnc-and-the-law-enforcement-data-service-leds-accessible

18 https://www.gov.uk/government/collections/justice-data-lab-pilot-statistics

19 PSM is a statistical technique where observable factors associated theoretically and empirically with the treatment group and outcome variable are used to derive a matched comparison group of individuals who were not subject to the intervention.

20 The two year period from the end of the data collection period is composed of: a 12 month time horizon for any reoffending to occur; six months to allow any court proceedings to complete; and the remaining six months for all necessary data to be uploaded onto management information systems.

21 The Offender Assessment System (OASys) measures the criminogenic risks and needs of offenders in England and Wales. (See https://assets.publishing.service.gov.uk/media/5a7f676fed915d74e33f6380/research-analysis-offender-assessment-system.pdf for more information and the history of OASys.)

they been released to reside in the one of the participating police force areas, based on the available MI.

The comparison group for this analysis was limited to contemporaneous prison leavers who: (i) were released on an adult licence of at least 30 days duration; (ii) had been convicted as an adult; (iii) served a standard determinate custodial sentence of at least 12 months; (iv) had an eligible AC offence type recorded as their principal offence type; and (v) were explicitly recorded as being released initially to live in a non-participating police force area.

The treatment group was based on individuals who were actually enrolled in the AC Project and where it was clear from the available management information that they met the project's eligibility criteria. The same eligibility criteria were therefore employed for the comparison group, with the exception of the police force area.

PSM was conducted separately for each intermediate outcome with regard to a complete set of 23 variables, including binary assessments of eight criminogenic factors and one variable to represent whether the individual was a member of the treatment or comparison group. The PSM took account of the total sentence length imposed, whether the index offence was theft or robbery, the number of prior disposals and whether HDC was used.

Regressions of the matched treatment and comparison groups were also conducted on the likelihood of recall to prison, the frequency of formal probationary warnings for licence breach and the overall probationary compliance rate[22] within 12 months of release from prison or the sentence expiry date, whichever was sooner. The rationale for conducting both PSM and regressions of the matched sample was to limit any residual bias post-matching and thus ensure that the treatment effect estimate was more robust.

Appropriate tests were applied to assess whether there were statistically significant differences between the matched groups in relation to these intermediate outcomes.

[22] Probationary compliance has been defined in terms of any "contact type" event recorded on nDelius that resulted in a binary yes/no outcome. See Appendix H for further details of this measure.

A sensitivity analysis was also undertaken that excluded the eight criminogenic factors and other variables recorded in OASys.

Further details of these methods and results can be found in Appendices D, F, G and H.

Police impacts

A difference-in-differences analysis was used to estimate the number of arrests that were avoided in the participating police forces as a consequence of the AC Project. Further details and the results are contained in Appendix I.

With regard to outturns related to the project's crime mapping facility, the number of crime searches, associated matches, proximity alerts and eventual prosecution outcomes was based on figures compiled by the MoJ's AC Hub, all of which were reported by the police.

3.2 Limitations

In general, the impact evaluation was wholly reliant on data obtained from both the main EM service provider and the MoJ's management information systems, neither of which was designed for research purposes. The data were incomplete and likely subject to input errors, which could have materially affected any of the conclusions drawn.

Reoffending analysis

There are some notable caveats to the methodology used which should be considered when interpreting the findings.

Importantly, given the complexity and lack of data for some variables, the PSM model was not able to account for all the potential confounding variables that may influence the matching of the 12 month+ cohort's treatment group to a valid comparison group.

Moreover, while there was no significant difference between the distributions of characteristics between the pre-matched and post-matched groups of individuals, the MoJ's Justice Data Lab excluded certain subgroups from the treatment group – i.e., individuals who had past sex offences due to their materially different reoffending patterns; all women enrolled in the AC Project due to their limited numbers; and anyone whose EM

order start date was more than 14 days after their prison release date so as to reflect an intention-to-treat.[23]

Consequently, care should be taken when interpreting the reoffending analysis results in the context of the project's entire 12 month+ cohort.

To elaborate, generalising all of the results to all of the 12 month+ cohort (as Appendix J does) means that the estimated number of avoided proven reoffences among treatment group members enrolled up to September 2023 may be materially higher or lower in reality.

HMPPS impacts

The lack of a reporting mechanism that routinely and reliably distinguished between the 12 month+ and 3-12 month AC cohorts meant there was a need to use a proxy, which was the total custodial sentence length imposed, as recorded in the available management information. The existence of any consecutive custodial sentences imposed for different offences means that some members of (what would have been) the 3-12 month AC cohort were likely included in the 12 month+ AC treatment and comparison groups with respect to each of the intermediate outcomes.

The PSM with regard to the likelihood of recall to prison, the average number of formal warnings for licence breach and the average compliance rate was based only on the common protected characteristics and criminogenic factors recorded. These intermediate outcome assessments were therefore less sophisticated and may have been less accurate than the reoffending analysis undertaken by the MoJ's Justice Data Lab, which made use of a wider range of variables.

Police impacts

The ability of difference-in-differences to make robust causal inferences about the avoided number of arrests is dependent on two fundamental assumptions.

- The treatment and comparison groups would have had parallel trends in the number of adult arrests by offence type between 2020/21 (the year before go-live)

[23] An important reason for delays in beginning an EM order was an otherwise eligible prison leaver being released into "no fixed abode". Probation practitioners were able to postpone enrolment in such cases.

and 2023/24 (the most recent year for which data are available) without the AC Project. The effect of the Covid-19 pandemic in the United Kingdom during 2020/21 could have impaired the usefulness of that year as a baseline, and published figures on the number of adult arrests indicated that the parallel trends assumption did not hold exactly in the years up to 2020/21.

- The composition of the project's treatment and comparison groups was stable over the time period. This is considered likely given that the 19 participating police force areas in the AC Project represented half of the England and Wales resident population.[24]

Separately, the use of proxies to account for the specific 12 month+ cohort and the subset of theft offences within the scope of the AC Project could have produced biased estimates of the avoided number of adult arrests for that cohort. Particular caution should therefore be taken when using these estimates.

With respect to the proximity alerts provided to the police that reportedly resulted in prosecutions and convictions, it should be noted that an unknown proportion of these outcomes would have arisen in any event because of other evidence presented in court that was unrelated to the use of GPS location monitoring. Separately, recording practices by participating police forces changed in early 2025 following the realisation that some prosecution outcomes attributed to the AC Project by the police did not in fact relate to monitored individuals.

It is also the case that the project's comparison group contained a mixture of non-participating police force areas in which IOM was more or less available during the early 2020s. The availability of IOM was a factor underlying the selection of police force areas that would be invited to participate in the AC Project.

[24] Published figures show that the 19 participating police force areas contained 50.4 per cent of the resident population of England and Wales as of mid-2022. (Source: Table P3, https://www.ons.gov.uk/peoplepopulationandcommunity/crimeandjustice/datasets/policeforceareadatatables)

4. Impact evaluation results

4.1 Longer-term impacts: reoffending

A more detailed discussion of the proven reoffending analysis undertaken for the AC Project's 12 month+ cohort is set out in Appendix B. A summary of the main conclusions is set out below.

Rate of reoffending

The proportion of male prison leavers who committed at least one proven reoffence during the 12 months following release was statistically significantly different[25] between the treatment and comparison groups.[26] Table 1 shows that the reoffending rate of the project's 12 month+ treatment group was seven percentage points lower than the comparison group, which represented a decline of about a fifth. The 95 per cent confidence intervals are also provided in Table 1 and in subsequent tables.

Table 1: Proportion of male AC prison leavers and comparison group reoffending within 12 months, April 2021 – June 2022

Treatment group rate (n=500)	Comparison group rate (n=1,208)	Estimated difference	p-value	Statistically significant?
26.2% (22.3% to 30.0%)	33.2% (30.6% to 35.9%)	-7pp (-12pp to -2pp)	<0.01	Yes

Frequency of reoffending

There was also a statistically significant difference in the average frequency of reoffending within 12 months of release. Table 2 shows that on average there were 0.35 fewer

[25] "Statistical significance" tests whether an observed difference in a variable is real or a product of random variation. Two hypotheses are constructed: a null hypothesis that there is no difference; and an alternative hypothesis that there is a genuine difference. The "p-value" is a number that helps determine the significance of the observed difference. It represents the probability that the observation would occur if the null hypothesis were true. A critical threshold of $p<0.05$ is commonly employed.

[26] There were large variations in the proportion of the reoffending analysis time horizon during which the AC Project's 12 month+ cohort was enrolled. Although the median period of enrolment among the cohort was found to be 174 days, almost a quarter of the cohort was enrolled for the maximum 12 month period from the point of release from prison and close to one-third was enrolled for at least 300 days.

reoffences per offender in the project's 12 month+ treatment group than the comparison group in the 12 months following release, which represented a decline of a third.

Table 2: Average number of reoffences per male offender among AC prison leavers and comparison group within 12 months, April 2021 – June 2022

Treatment group average (n=500)	Comparison group average (n=1,208)	Estimated difference	p-value	Statistically significant?
0.69 (0.55 to 0.83)	1.04 (0.92 to 1.16)	-0.35 (-0.53 to -0.16)	<0.01	Yes

Time to reoffence

In terms of those prison leavers who did commit a reoffence, there was no statistically significant difference in the average time to the first proven reoffence within 12 months between the project's 12 month+ treatment and comparison groups, as shown in Table 3.

Table 3: Average number of days to first reoffence among male AC prison leavers and comparison group within 12 months (reoffenders only), April 2021 – June 2022

Treatment group days (n=131)	Comparison group days (n=408)	Estimated difference	p-value	Statistically significant?
140 (124 to 156)	131 (121 to 140)	+9 (-9 to +28)	0.32	No

Reoffence mix

Table 4 sets out the distribution of known offence types on an all proven reoffences basis within 12 months of release for the project's 12 month+ treatment and comparison groups.

Table 4: Reoffence mix of male AC prison leavers and of comparison group within 12 months, April 2021 – June 2022

Broad offence group	Treatment group reoffences (n=346)	Comparison group reoffences (n=508)	p-value
Theft	39%	39%	0.95
Summary non-motoring	16%	14%	0.48
Summary motoring	16%	13%	0.25
Drugs	11%	8%	0.13
Violence against the person	5%	6%	0.49

Broad offence group	Treatment group reoffences (n=346)	Comparison group reoffences (n=508)	p-value
Miscellaneous crimes against society	5%	5%	>0.99
Fraud	3%	3%	0.75
Public order offences	2%	2%	0.79
Possession of weapons	2%	5%	<0.01
Robbery	1%	4%	0.02
Criminal damage & arson	1%	0%	0.04
Sexual offences	0%	0%	>0.99

Although the share of all robbery reoffences was a statistically significant three percentage points lower in the treatment group (1% versus 4%), there was no difference in the share of all theft reoffences.

Further details are contained in Appendix C.

Avoided reoffences

Given that there were approximately 3,360 AC orders involving an EM tag installation that completed between 2021/22 and 2023/24, it is inferred that the project's 12 month+ treatment group resulted in around 235 fewer reoffenders and roughly 1,200 fewer reoffences, of which about 60 per cent were either theft or summary offence types.

It should be noted, however, that this inference assumes that the results of the proven reoffending analysis for male prison leavers in the period up to June 2022 can be generalised to all of the 12 month+ cohort enrolled up to September 2023.

See Appendix J for more details.

4.2 Intermediate outcomes: HMPPS

Recall rate

There was no statistically significant difference in the rate of recall to prison between the AC 12 month+ treatment and comparison groups, as shown in Table 5. The time period was within 12 months of release or the sentence expiry date, whichever was earlier.

Table 5: Average recall rate of AC prison leavers and comparison group within 12 months, April 2021 – September 2023

Treatment group rate (n=626)	Comparison group rate (n=626)	Estimated difference	p-value	Statistically significant?
62.6% (58.8% to 66.4%)	62.0% (58.2% to 65.8%)	+0.6pp (-6pp to +5pp)	0.82	No

This finding was supported by the subsequent regression model. Further details of this analysis are contained in Appendices D and F.

Formal warnings for licence breach

As can be seen in Table 6, there was no statistically significant difference between the AC 12 month+ treatment and comparison groups regarding the average number of formal warnings received from the Probation Service for licence breaches. The time period was within 12 months of release or the sentence expiry date, whichever was earlier.

Table 6: Average number of formal warnings issued to AC prison leavers and comparison group within 12 months, April 2021 – September 2023

Treatment group average (n=626)	Comparison group average (n=626)	Estimated difference	p-value	Statistically significant?
0.57 (0.48 to 0.66)	0.59 (0.50 to 0.68)	-0.02 (-0.10 to +0.15)	0.73	No

This finding was supported by the subsequent regression model. Further details of this analysis are contained in Appendices D and G.

Overall rate of compliance

Table 7 shows that there was no statistically significant difference between the overall rate of probationary compliance[27] between the AC 12 month+ treatment and comparison groups. The time period was within 12 months of release or the sentence expiry date, whichever was earlier.

[27] The probationary compliance rate has been defined in terms of the share of any “contact type” event recorded on nDelius that resulted in a “yes” outcome among all binary yes/no outcomes. See Appendix H for further details of this measure.

Table 7: Average compliance rate of AC prison leavers and comparison group within 12 months, April 2021 – September 2023

Treatment group rate (n=611)	Comparison group rate (n=611)	Estimated difference	p-value	Statistically significant?
81.0% (79.7% to 82.3%)	81.2% (79.9% to 82.6%)	-0.2pp (-2pp to +2pp)	0.83	No

This finding was supported by the subsequent regression model. Further details of this analysis are contained in Appendices D and H.

Administrative burden

Staff working in the Probation Service spent time in delivering the AC Project that they would not otherwise have had to expend. Table 8 provides estimates of this time commitment with respect to the project's 12 month+ cohort during the first three years of operation, which was based on HMPPS "should take" estimates of the time associated with a range of distinct activities by probation staff.

Table 8: Estimated hours of time spent by HMPPS staff, 2021/22 – 2023/24

AC 12 month+ cohort	Estimate
Approx. time spent, hours	140,000
of which time spent reviewing AC portal	*110,000*

Source: Probation Workforce Transformation team, HMPPS

The total number of work hours was spent on various pre-release and post-release activities, including dealing with the EM violations that arose.[28] The activities in question were undertaken by HMPPS staff at different grades. Around 80 per cent of the estimated total time expended on the AC Project related specifically to staff having regularly to use the AC Portal to review the location monitoring information of individuals enrolled in the project.

[28] Limitations in the available EM violations data meant that it was only possible to identify a total of around 2,400 incidents of GPS EM tag and Home Monitoring Unit tampers among the 12 month+ cohort over the entire period. (Any HDC violations were ignored because these were independent of GPS location monitoring.) In addition, probation staff would have carried out a range of AC Project-specific activities in relation to eligible cases that did not ultimately result in a successful tag installation. Table 12 may therefore be considered to contain conservative estimates of the time impact on HMPPS.

4.3 Intermediate outcomes: Police

Arrests

The AC Project process evaluations (Yates et al., 2025) of both the 12 month+ and 3-12 month cohorts found that police officers' largely positive view of the project was partly a consequence of being able to dismiss potential suspects from criminal investigations more easily due to the crime mapping of location monitored individuals. It therefore follows that there could have been fewer arrests in the participating police forces than would otherwise have been the case as a result of the project.

Based on a Difference-in-Differences methodology using published statistics on the number of adult arrests by offence type between 2020/21 (the year before go-live) and 2023/24 (the most recent year for which data are available), it is indicatively estimated that the project's 12 month+ cohort could have resulted in roughly 16,000 fewer adult arrests than otherwise for theft and robbery overall in the participating police forces between 2021/22 and 2023/24.

This inferred number of avoided arrests was equivalent to some 16 per cent of the estimated 106,000 counterfactual total number of AC Project-specific adult arrests for theft and robbery across the participating police forces over the time period.

Further details of this analysis based on the Difference-in-Differences approach are contained in Appendix I.

Crime mapping

A feature of the AC Project was the sharing of relevant GPS location data with the participating police forces in response to an acquisitive offence that was reported to the police and analysed by the project's crime mapping tool.

Based on data provided to the MoJ's AC Hub by participating police forces, Table 9 summarises the number of crime searches conducted and matches obtained to all AC Project location monitored individuals in the period up to the end of 2024, regardless of cohort.

Table 9: Number of crime searches and their outcomes, April 2021 – December 2024

Category	Crime searches	Automated matches	Proximity alerts
Number	1,204,761	68,474	31,963

Crime searches = Number of crimes submitted to the MoJ's AC Hub by police forces.
Automated matches = Number of matches to location monitored individuals (i.e., two consecutive GPS "pings" within 100 metres of a reported acquisitive offence and within the time period[29] specified).
Proximity alerts = Number of reports sent to police forces in respect of a crime search resulting in a quality assured match (where each report could include multiple location monitored individuals per crime).

It is evident that most crime searches (over 99%) did not result in any matches to monitored individuals under the AC Project over the period.

Proximity alert outcomes

Following receipt of a proximity alert from the MoJ Hub, the police would use this information to support the criminal investigation of a reported acquisitive offence. One successful outcome is therefore a summons/charge[30] that results in a conviction among location monitored individuals enrolled in the AC Project.

Table 10 sets out the number of summonses/charges against monitored individuals and their associated outcomes, as reported by the police at the end of 2024, regardless of cohort.[31]

Table 10: Outcomes of proximity alerts given to the police, April 2021 – December 2024

Category	Proximity alerts	Summonses/Charges
Number	31,963	237
of which convictions	*163[32] (0.5%)*	*163[32] (69%)*

[29] Up to a maximum of 12 hours of when the offence was believed to have occurred, plus 10 minutes (which is automatically added by the crime mapping tool to the specified time period).

[30] All prosecutions in England and Wales begin by either a person receiving a summons to attend court or by being charged with an offence following arrest. A summons is essentially a written order to attend a court in response to an alleged offence. If a person is charged, they are given written details of the charges and bailed to attend court. If bailed, a person must attend in person. A person who is summonsed usually does not have to attend in person if they instruct a solicitor to attend on their behalf.

[31] One person can be prosecuted for more than one specific offence at the same time. There were an estimated 138 unique individuals among the total number of summonses/charges reported by participating police forces up to December 2024 under the AC Project.

[32] The remaining summonses/charges resulted in an acquittal, a discontinued prosecution or an outcome that was still pending by the end of 2024.

The available data indicate that, among the proximity alerts provided to the police forces participating in the AC Project, most (about 99%) did not lead to a summons or charge.

Moreover, the number of convictions reportedly arising due to the project's crime mapping facility represented under one per cent of all relevant convictions that took place across the participating police force areas.[33]

It is unknown to what extent the limited number of reported prosecutions and convictions was the product of a deterrent effect that was itself the direct result of crime mapping. It is important also to note the likely effects on offenders due to the physical awareness of wearing an EM GPS tag and the ongoing probationary supervision that was informed by location monitoring.

It should be emphasised, moreover, that it is unknown the extent to which AC location monitoring information was critical in securing the prosecution or conviction of any reoffender. Separately, it has since been established that reporting practices within some police forces over the period have resulted in an unknown share of prosecutions having been attributed to the AC Project when in fact the suspect was not actually enrolled in the project. Reporting practices were changed in early 2025 as a consequence.

Administrative burden

The 19 participating police forces were obliged to spend time in dealing with the proximity alerts received as a result of crime mapping under the AC Project that they would not otherwise have had to expend. Table 11 provides an indicative estimate of the total number of numbers expended, assuming 20 minutes of police officer time per proximity alert.[34]

[33] There were around 19,000 adult defendants convicted of an AC Project specified offence type between April 2021 and June 2024, where Q1 2024/25 was the most recent quarter for which published data were available and where the recorded police force area was one of the police forces participating in the project, taking into account that 13 of them did not participate before October 2021. (See "Outcomes by offences data tool: June 2024", https://www.gov.uk/government/statistics/criminal-justice-system-statistics-quarterly-june-2024)

[34] Average based on anecdotal information.

Table 11: Estimated hours of time spent by police, 2021/22 – 2023/24

AC 12 month+ cohort	Estimate
Approx. number of proximity alerts[35]	21,000
Approx. time spent by police, hours	7,000

External Agency Requests

The police can request retrospective location monitoring information on specific individuals that was not provided by the MoJ's AC Hub as part of a routine acquisitive crime search.

This is known as an External Agency Request (EAR), which is permitted if it relates to the prevention or detection of crime and/or the apprehension or prosecution of particular offenders. However, an EAR is rejected if it does not meet the requirements of the Data Protection Act 2018 or if the requested information does not exist.[36] Consequently, any prison leaver who was enrolled in the AC Project could potentially have their monitoring data disclosed to the police or other public bodies for wider law enforcement purposes.

Table 12 shows the total number of EARs received in relation to AC Project monitored individuals, regardless of the specific cohort, and their recorded outcomes between 2023 and 2024.[37]

Table 12: EARs submitted by the police and their outcomes, January 2023 – December 2024

Category	Number	Share
AC Project EARs	607	100%
Accepted	462	76%
Rejected	145	24%

[35] This figure differs from that shown in Tables 9 and 10, where the earlier tables show the recorded number of proximity alerts up to December 2024, regardless of AC cohort. The estimate in Table 11 relates to the period up to March 2024 and has been estimated to focus only on the 12 month+ cohort.

[36] EARs must explain why access to the particular information is necessary, how the requested data will facilitate that aim and the nature of any urgency. If the data request is too broad in scope or unclear, then it must be rejected.

[37] The available data before 2023 did not include an EM order type.

One can see that around three-quarters of the approximate 600 EARs were accepted and that the remainder was rejected for various reasons.[38]

It is unknown whether any of the data provided through an accepted EAR resulted in a subsequent prosecution or conviction.

[38] Where recorded, the dominant reason for rejecting an EAR over the time period was the absence of any location monitoring data during the timeframe in question. The two next most common reasons, where recorded, were that the EAR was found to be too broad in nature and that the data request was technically invalid (e.g., a missing countersignature).

5. Conclusions

5.1 Research questions

There were three research questions for the impact evaluation of the AC Project's 12 month+ cohort. They are answered below.

What was the effect on reoffending within 12 months of release from prison?
The proven reoffending analysis undertaken by the MoJ's Justice Data Lab found that the intervention was associated with a statistically significant seven percentage point reduction in the 12 month rate of reoffending (from 33.2% to 26.2%) among male prison leavers who were compulsorily enrolled in the project's 12 month+ cohort up to June 2022. It was also found that their average frequency of reoffending within this time period fell by a statistically significant 0.35 reoffences per offender (from 1.04 to 0.69). However, there was no significant difference in the average number of days to their first reoffence (around 131 days post-release).

Consequently, one can conclude that the intervention had a material impact on the likelihood and frequency of proven reoffending within 12 months of release, but not on the time to reoffence.

What was the effect on the intermediate outcomes of recall to prison, licence breach and probationary compliance within 12 months of release?
Based on Propensity Score Matching and the MoJ's available management information, there were no statistically significant differences detected between the treatment and comparison groups' 12 month rates of recall, average number of formal warnings for licence breach or individuals' average rates of compliance among prison leavers during the study period.

One can therefore conclude that the intervention did not produce any other behavioural impacts beyond the observed reoffending deterrent effect.

There was, however, an administrative burden on HMPPS of some 140,000 work hours in delivering the AC Project's 12 month+ cohort between 2021/22 and 2023/24.

What was the effect of crime mapping on police investigations?

The more limited data available suggest that the AC Project's crime mapping facility and resulting provision of proximity alerts to participating police forces up to 2023/24 was associated with a reduction of roughly 16,000 adult arrests for acquisitive offences in respect of the 12 month+ cohort. However, management information shows that over 99 per cent of crime searches submitted by the police did not result in a proximity alert (i.e., useable intelligence for the police) and that 99 per cent of proximity alerts were not associated with a subsequent summons or charge.

In short, based on the qualitative evidence from police respondents and quantitative evidence based on published arrest data, it is inferred that the project's crime mapping facility did contribute to more efficient police investigations of reported acquisitive offences in general, but it did not deliver an appreciable increase in the number of prosecutions or convictions covered by the AC Project.

It is unknown whether this limited increase was due to a deterrent effect caused directly by crime mapping alone or also by offenders' general awareness of an EM GPS tag and/or by ongoing probationary supervision informed by location monitoring.

Separately, it was indicatively estimated that there was an administrative burden on the participating police forces of around 7,000 work hours in delivering the project's 12 month+ cohort between 2021/22 and 2023/24.

5.2 Reflections on findings

The conclusions that the AC Project's 12 month+ cohort was associated with a statistically significant decline in proven reoffending, but not with any detectable effect on the intermediate outcomes of most relevance to the Probation Service, collectively point to the intervention acting as a partial situational barrier to reoffending among prison leavers enrolled in the project rather than a more general driver of offender behaviour.

The reoffence mix was dominated by the theft and summary broad offence types, which represented 66 per cent of all reoffences within 12 months of release among the comparison group. In contrast, the more serious offence types of violence against the person and robbery together represented only 10 per cent of all reoffences within 12 months among the comparison group.

Given the focus of the impact evaluation in assessing the effectiveness of the AC Project relative to the status quo, it is possible that an alternative approach to modifying the behaviour of acquisitive offenders leaving prison could have achieved superior and/or longer lasting outcomes.

For instance, it is noteworthy that, with regard to the findings of a rapid evidence assessment regarding effective interventions focused on acquisitive offenders, Stewart and Usher (2017) concluded that a successful strategy to combat this form of offending should include:

i. substance misuse treatments (e.g., opiate substitution therapy) for offenders who have a drug dependency, given its prevalence among this group; and
ii. behavioural programmes that address cognitive deficits linked to self-control (e.g., consequential thinking programmes to help individuals weigh the likely negative consequences of reoffending).

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Appendix A: AC Project eligible offences

The table below sets out the five digit Home Office (HO) offences codes for the specific offences in scope of the AC Project.

HO Code	Offence	Detailed offence
02801	28.1 Burglary in a Dwelling - indictable only	Burglary in a dwelling with intent to rape - indictable only
02802	28.1 Burglary in a Dwelling - indictable only	Burglary in a dwelling with intent to inflict grievous bodily harm - indictable only
02803	28.2 Burglary in a Dwelling - triable either way	Other burglary in a dwelling
02900	29 Aggravated Burglary in a Dwelling	Aggravated burglary in a dwelling
03001	30A.1 Burglary in a Building Other than a Dwelling - indictable only	Burglary in a building other than a dwelling with intent to rape - indictable only
03002	30A.2 Burglary in a Building Other than a Dwelling - triable either way	Burglary in a building other than a dwelling with intent to steal/inflict grievous bodily harm/commit damage - triable either way
03100	31 Aggravated Burglary in a Building not a Dwelling	Aggravated burglary in a building other than a dwelling
03401	34 Robbery	Robbery
03402	34 Robbery	Assault with intent to rob
03900	39 Theft from the Person of Another	Stealing from the person of another
04510	45 Theft from Vehicle	Theft from a motor vehicle
04511	45 Theft from Vehicle	Theft from a vehicle - other than a motor vehicle
04801	48 Theft of a motor vehicle (excl. aggravated vehicle taking) - triable either way (MOT)	Theft of a motor vehicle (excluding aggravated vehicle taking) - triable either way

Appendix B: Reoffending analysis

Background

Propensity Score Matching (PSM) is a quasi-experimental method of deriving a counterfactual for an intervention. It estimates the conditional probability, represented by the propensity score, of receiving the intervention based on a series of covariates.

The list of covariates is assumed to be sufficiently broad to encompass all relevant factors that determine assignment to the intervention, while also being associated with the outcome.

Each member of the treatment group is given a propensity score, which is then used to identify members of a comparison group, who by definition did not receive the intervention. For a successful match to the treatment group under PSM, the estimated propensity score for the untreated individual has to fall within 0.1 standard deviations of that of the treated individual ("within tolerance").

In line with the standard methodology[39] of the MoJ's Justice Data Lab, radius matching was used. Where multiple comparison group members propensity scores fall within tolerance for a treatment group member, the comparison group individuals are given an equal weighting factor. If no individuals from the comparison group fall within tolerance for a given treatment group member, the treatment group member is excluded from the analysis.

Application to the AC Project

The PSM was undertaken by the MoJ's Justice Data Lab, which is an expert team within the Department's Analysis Directorate that regularly conducts these statistical investigations. The Police National Computer (PNC) was an important database employed in the reoffending analysis.

In terms of the proven reoffending analysis for the 12 month+ cohort of the AC Project, the comparison group was based on the prison leavers who met the project's eligibility criteria

[39] https://www.gov.uk/government/publications/justice-data-lab

and who were released to live in one of the police force areas that were not participating in the project. The specific eligibility criteria were:

- The individual was convicted as an adult for an in-scope acquisitive crime (see Appendix A), which was their longest or joint longest custodial sentence length.
- The individual was serving a standard determinate sentence of 12 months or more and had at least 30 days remaining on licence at the point of release from prison.
- The individual was released to reside in an eligible police force area, which was:
  - Avon & Somerset, Cheshire, Gloucestershire, Gwent, Humberside or West Midlands between 12 April 2021 and 28 September 2021; and
  - Avon & Somerset, Cheshire, Gloucestershire, Gwent, Humberside, West Midlands, Bedfordshire, City of London, Cumbria, Derbyshire, Durham, Essex, Hampshire, Hertfordshire, Kent, Metropolitan (i.e., Greater London), North Wales, Nottinghamshire or Sussex from 29 September 2021 onwards.
- The individual must not meet any of the exemption criteria of residing at an address without an electricity supply, possessing a physical impairment preventing them for wearing tag on their ankle and/or is mentally unable to comply with requirements of EM.

Numerical data on the AC order starts that arose between April 2021 and June 2022 and that resulted in a successful tag installation were provided by the main EM service provider to the MoJ as part of the business-as-usual activities required by contract.

This dataset was then linked to wider data contained in nDelius, which is the management information system of the Probation Service, and OASys, which measures the strength of different criminogenic factors. Individuals who did not receive an AC order within 14 days of release from prison were excluded from the treatment group to manage delays in exposure to AC EM tagging. Consequently, this analysis took an intention-to-treat design.

The following flow diagram and subsequent table shows the construction of the treatment group and comparison to those prison leavers not included for the purposes of reoffending analysis.

1389 records submitted for period up to 30 June 2022

1389

10 records (1%) excluded as they could not be identified on the PNC

1379

97 records (7%) excluded because they did not have a record in the reoffending database, or where a single AC participation was selected for an individual with multiple participations

1282

41 people (3%) excluded with a history of sexual offences[40]

1241

113 people (8%) excluded with ineligible custodial length bands and Home Office codes

1128

190 people (14%) excluded due to release dates outside the analytical window

938

45 people (14%) excluded with gender female

893

93 people (7%) excluded who could not be linked to nDelius[41], or with ambiguous eligibility information across multiple nDelius records

800

45 people (3%) excluded with more than 14 days between release and EM order start date

755

27 people (2%) excluded who could not be linked to a PFA or were in an out-of-scope PFA

728

500 individuals matched at PSM stage

[40] Individuals with sexual offences are excluded from JDL analyses, in line with standard practice, on the grounds that this offender subgroup has notably different reoffending patterns from other offender types. However, individuals convicted of sexual offences are not necessarily "sex offenders". This concept is essentialising, and contains assumptions about why and how individuals commit sexual offences which cannot be determined by offending history data. The JDL has excluded individuals with sexual offences from the analysis, pending further methodological development.

[41] Excludes those who could not be linked to nDelius records, including all remaining female records.

	Participants included in analysis (n=500)	Participants not included in analysis (n=782)
Sex: Male	100%	93%
Sex: Female	0%	7%
Ethnicity: White	84%	79%
Ethnicity: Black	11%	12%
Ethnicity: Asian	4%	6%
Ethnicity: Other	0%	1%
Ethnicity: Unknown ethnicity	1%	3%
Nationality: UK nationality	97%	98%
Nationality: Non-UK nationality	3%	2%
Nationality: Unknown nationality	0%	1%

To determine the location of release for an offender nDelius records of the location of an individual's offending manager was used to link to the PNC database and the Probation Delivery Unit (PDU) and then the police force area. This produced a linking rate of 97.3 per cent. Due to the geographical differences between the two groups, spatial confounding was controlled insofar as possible. This was done by incorporating spatial information from the 2021 Census into the matching model.

Use of PSM

The PSM process has several (often competing) goals, which are outlined as follows:

- to match treatment group records to comparison group records with as close a propensity score as possible;
- to have all variables in the model as closely matched at an aggregate level for the post-matched groups; and
- to end up with a post-matched treatment group that is as representative as possible to the pre-matched treatment group.

The most important goal was to minimise the mean absolute standardised difference (MASD) of all variables in the final model, ensuring the best possible balance between the post-matched groups on all variables in aggregate. A caliper of 0.00431 was used within

the radius matching method to minimise the MASD. As a consequence of this matching process, the proportion of the pre-matched group that were matched was 69 per cent (i.e., 500 of 728 individuals).

Using PSM, the treatment and comparison group members were then matched using 73 factors derived from PNC records, prison release records, the 2021 Census and nDelius. The MASD between the matched treated and comparison groups was 2.22 per cent, which indicates that a good quality of matching was achieved, given the recorded variables.

Five variables included in the model had an SMD above five per cent: being of a black ethnicity; the OASys variable 'Recognises the impact and consequences of offending on the victim/community/wider society'; median house price; proportion of population with Level 1 and entry qualifications or no qualifications; and net annual earnings before housing costs.

The highest SMD included in the model was 11 per cent.

See the following table for details of the full sensitivity analysis.

Sensitivity	Explanation	Findings
Standard approach	The chosen approach for this analysis is displayed here for comparison against other sensitivities. Radius matching (with replacement) was applied.	88 variables were included in the final model with a mean absolute standardised difference of 2.2%.
Exclusion of OASys (including OVP and OGRS) variables from the model	To explore the effect of including OASys data in the model.	56 variables were included in the final model with a mean absolute standardised difference of 2.5%. Overall, the results were similar to the standard approach with treatment effects in the same direction for all three reoffending outcome measures. In terms of statistical significance, the only difference observed was that the days to first reoffence measure

Sensitivity	Explanation	Findings
		produced a significant result (p= 0.03) for this sensitivity.
Exclusion of cases with an indeterminate Integrated Offender Management (IOM)[42] type	In the Delius dataset, some individuals had multiple IOM types linked to the same index date. These cases were removed for this sensitivity.	89 variables were included in the final model with a mean absolute standardised difference of 3.0%. The results were similar to the standard approach.
Change of PFA metrics used for geo-matching	The PFA metrics used for geo-matching in the headline model were excluded and replaced with two metrics taken from the proven reoffending statistics which are a binary and frequency measure of reoffending at a PFA level.	79 variables were included in the final model with a mean absolute standardised difference of 2.1%. The results were similar to the standard approach.

List of variables

The final list of variables employed by the MoJ's Justice Data Lab is shown in the table below. There were serval OASys variables investigated for use in the PSM model that ultimately were not included due to their limited coverage. Variables were chosen based on their theoretical and empirical associations with reoffending (the outcome variable) and being enrolled in the AC project (membership of the treatment group).

Variable name/description	Data source
Ethnicity, as recorded by police officer	PNC
UK nationality	PNC
Year of release from prison – reoffending cohort	PNC
Offender's age at release	PNC
Home Office offence group	PNC

[42] For more information on IOM, see https://hmiprobation.justiceinspectorates.gov.uk/effective-practice/effective-practice-guide-integrated-offender-management/

Variable name/description	Data source
Disposal code	PNC
Prison sentence length band. Null = No prison sentence, b: Less than or equal to 6 months, c: More than 6 to less than 12, d: 12 months to < 4 years, e: 4 years to 10 years, f: more than 10 years, IPP, MLP, Other Life	PNC
Severity tier that the index offence falls into - either T1 (Most severe), T2 or T3 (least severe)	PNC
Number of previous offences, excluding Penalty Notices for Disorder (PNDs), prior to the index offence	PNC
Copas rate, excluding PNDs.	PNC
Number of previous custodial sentence events prior to the date of index offence	PNC
Number of previous conviction events prior to the date of index offence (essentially number of previous times when offender has been sentenced in court).	PNC
Age at which the offender first came into contact with the CJS	PNC
Number of previous T1 serious offences, excluding PNDs, prior to date of index offence	PNC
Number of previous T2 serious offences, excluding PNDs, prior to date of index offence	PNC
Number of previous T3 serious offences, excluding PNDs, prior to date of index offence	PNC
Number of previous offences with unknown/ambiguous ITS tier, excluding PNDs, prior to date of index offence	PNC
Number of previous violent offences, excluding PNDS, prior to index offence	PNC
Number of previous robbery offences, excluding PNDS, prior to index offence	PNC
Number of previous public order offences, excluding PNDS, prior to index offence	PNC
Number of previous sexual offences, excluding PNDS, prior to index offence	PNC
Number of previous domestic burglary offences, excluding PNDS, prior to index offence	PNC
Number of previous other burglary offences, excluding PNDS, prior to index offence	PNC
Number of previous theft (non-motor) offences, excluding PNDS, prior to index offence	PNC

Variable name/description	Data source
Number of previous handling offences, excluding PNDS, prior to index offence	PNC
Number of previous fraud and forgery offences, excluding PNDS, prior to index offence	PNC
Number of previous vehicle theft offences, excluding PNDS, prior to index offence	PNC
Number of previous drink driving offences, excluding PNDS, prior to index offence	PNC
Number of previous criminal damage offences, excluding PNDS, prior to index offence	PNC
Number of previous drugs imp/exp/prod/supply offences, excluding PNDS, prior to index offence	PNC
Number of previous drug possession and supply offences, excluding PNDS, prior to index offence	PNC
Number of previous breach offences, excluding PNDS, prior to index offence	PNC
HDC length	NOMIS
Does the offender recognise the impact and consequences of offending on victim/community/wider society?	OASys
Currently of no fixed abode or in transient accommodation	OASys
Suitability of accommodation	OASys
Permanence of accommodation	OASys
Suitability of location of accommodation	OASys
Accommodation issues linked to risk of serious harm, risks to the individual and other risks	OASys
Accommodation issues linked to offending behaviour	OASys
Is the person unemployed, or will be unemployed on release?	OASys
Has problems with reading, writing or numeracy	OASys
Has learning difficulties (Has learning or behavioural problems, attended a special school)	OASys
Education/training/employability issues linked to offending behaviour	OASys
What is the offender's financial situation?	OASys
Financial issues linked to offending behaviour	OASys
Current relationship with close family members (Relationships with parents, siblings, grandparents and any other family or step-family members with whom s/he has regular contact)	OASys

Variable name/description	Data source
Relationship issues linked to offending behaviour	OASys
Lifestyle and associates issues linked to offending behaviour	OASys
Drug misuse issues linked to offending behaviour	OASys
Alcohol misuse issues linked to offending behaviour	OASys
Current psychological problems/depression (Psychological dysfunction or symptoms diagnosed by a GP, psychiatrist or clinical psychologist, including any history or treatment of phobias or hypochondria)	OASys
Issues of emotional well-being linked to offending behaviour	OASys
Thinking/behaviour issues linked to offending behaviour	OASys
Attitudes linked to offending behaviour	OASys
General Health - does the offender have any physical or mental health conditions which need to be taken into account (e.g. pregnancy, epilepsy, asthma, vertigo etc. any disability/access considerations)	OASys
Electronic monitoring - any adverse impact, to others at the address, of the offender's return on electronic monitoring	OASys
Is there a permanent electricity supply at the offender's address	OASys
Banded OGRS3 score. Bands used were low (0 <= OGRS < 25), medium (25 <= OGRS < 50), high (50 <= OGRS < 75), and very high (75 <= OGRS)	OASys
Current enrolment in any version of IOM at start of ACEM (yes/no)	nDelius
Proportion of households classified as having an occupancy rating of -1 or lower (at least 1 less bedroom than required)	ONS datasets
Households that are deprived in 3 or more measures of deprivation (employment, education, health and disability, and housing)	ONS datasets
Proportion of population with level 1 and entry level qualifications or no qualifications. Level 1 and entry level qualifications: 1 to 4 GCSEs grade A* to C , Any GCSEs at other grades, O levels or CSEs (any grades), 1 AS level, NVQ level 1, Foundation GNVQ, Basic or Essential Skills	ONS datasets
Claimants of JSA as a proportion of working age population	ONS datasets
Proportion of households with no access to central heating	ONS datasets
Proportion of households with access to 2 or more vans or cars	ONS datasets
Proportion of households with no access to a car or van	ONS datasets
Classification of an area as urban or rural	ONS datasets
Average working age population (age 16-64) as a proportion of the population	ONS datasets

Variable name/description	Data source
Residential population per hectare	ONS datasets
The number of public houses/bars/nightclubs per hectare	ONS datasets
The number of retail buildings (other than public house/bar/nightclub/restaurant/cafeteria) per hectare	ONS datasets
Median house price	ONS datasets
Household income: Net annual earnings before housing costs by MSOA	ONS datasets

In the light of previous reoffending analyses undertaken by the Justice Data Lab, the inclusion of interaction terms as candidate variables in the regression model does not usually yield much additional “useful information” beyond the large number of linear and squared variables originally employed.

Reoffending analysis limitations

The complexity and lack of data for some variables meant the PSM model was not able to account for all the potential confounding variables that could influence the matching of the treatment group to a comparison group. In particular:

- Recalls to prison were not taken into account. The unit of analysis was the individual, not the release from prison. Each individual therefore only appears once in the dataset, and the follow-up period corresponds to their first release from prison where they did (in the treatment group) or would have (in the comparison group) had an EM tag installed. Periods of recall to prison therefore appear in both the treatment and the comparison groups, and the standard Justice Data Lab assumption is that these should be balanced across the two groups.
- EM tags may be removed for a variety of reasons, such as an individual being recalled to prison or requiring a medical procedure. In these circumstances, there is a “clock-stop” under the AC Project such that the time until the tag is reinstalled is ignored. This was not captured in the reoffending analysis due to difficulties in controlling for it.

- If monitored individuals move out of a participating police force area, then their GPS EM tag has to be promptly removed. No data were available on the frequency of such events at an individual level or in aggregate, so the analysis was unable to control for this eventuality.
- While an indicator for Integrated Offender Management was included, its delivery can differ between offender cohorts and geographic regions in practice.
- Spatial modelling is complex to conduct and there is a general lack of research on the spatial determinants of criminal behaviours, so a best endeavours approach was employed by the Justice Data Lab.
- No individuals were removed from the treatment or comparison group based on AC Project exclusion variables (e.g., physical and/or mental disability) due to a lack of reliable indicators.
- Some subgroups of offenders were excluded from the treatment group. These were women, prior sex offenders and enrolled individuals whose EM order start dates were more than 14 days different from their prison release dates.
- The narrow scope of AC Project eligible offences resulted in the pre-matched pool of eligible comparison group individuals being relatively small and therefore produced a lower matching ratio than is customary for a reoffending analysis by the Justice Data Lab, although one that still met minimum standards.

Consequently, some bias may be present in the reported estimates of the effect of enrolment in the AC Project's 12 month+ cohort on proven reoffending, and there are risks in generalising the estimated reoffending effect to everyone who was enrolled in the project's 12 month+ cohort.

Appendix C: Distribution of all reoffences by offence type

The following table shows the offence mix of all proven reoffences within 12 months that were identified among the matched treatment and comparison groups of the AC Project's 12 month+ cohort.

For the avoidance of doubt, the table does not provide an indication of the probability of whether any reoffence occurs, which is the purpose of Table 1. Instead, the table below presents the percentage shares of offence types across the reoffences that did occur.

The estimates are rounded to the nearest one percentage point, so the totals do not sum to 100 per cent. The associated p-value is also listed, based on a two proportion Z-test.

Broad offence group	Treatment group reoffences (n=346)	Comparison group reoffences (n=508)	p-value
Theft	39%	39%	0.95
Summary non-motoring	16%	14%	0.48
Summary motoring	16%	13%	0.25
Drugs	11%	8%	0.13
Violence against the person	5%	6%	0.49
Miscellaneous crimes against society	5%	5%	>0.99
Fraud	3%	3%	0.75
Public order offences	2%	2%	0.79
Possession of weapons	2%	5%	<0.01
Robbery	1%	4%	0.02
Criminal damage & arson	1%	0%	0.04
Sexual offences	0%	0%	>0.99

N.B. Excluding unknown offence types (treatment = 8; comparison = 14)

A chi-square test of association of the "observed" number of all reoffences (i.e., members of the AC 12 month+ treatment group) and the "expected" number of all reoffences (i.e.,

based on the distribution of the comparison group) by broad offence type resulted in the conclusion that the two distributions were significantly different overall ($p<0.05$).

X^2 test statistic ≈ 23

Degrees of freedom = 11

p-value ≈ 0.02

However, the individual p-values indicated that the estimated percentage point differences were only statistically significant for three of the 12 broad offence types: possession of weapons; robbery; and criminal damage and arson. Only the percentage shares of the first two offence types exhibited significant declines relative to the comparison group, while the third offence type share saw a modest increase from zero.

Appendix D: Intermediate outcomes analysis based on PSM

Treatment and comparison groups

The AC Project treatment group was based on data from the main EM services provider.[43] This entailed all EM orders created, where a date of GPS tag installation or of tag removal was also recorded and where the classification was listed as "Acquisitive Crime" in the management information, regardless of whether they corresponded to the 12 month+ or 3-12 month cohort.

Using R Studio and based on the available data recorded in P-NOMIS and nDelius, the AC EM orders were filtered to ensure that each prison leaver:

- had an AC-eligible principal offence type recorded;
- had a standard determinate custodial sentence length of at least 12 months recorded that was not classified as a youth sentence;
- was released from prison on an adult licence between 12 April 2021 (date of project go-live) and 30 September 2023 (end point for analysis); and
- had a post-release licence period of at least 30 days.[44]

Duplicates were removed so that only unique releases of prison leavers were contained in the dataset, which meant that some individuals featured more than once if they were released from prison more than once over the period and re-enrolled in the project. In addition, any EM order whose recorded start date was five or more days different from the relevant recorded date of prison release was excluded.[45]

Following application of the aforementioned filters to all EM orders based on the contents of the management information systems, there were 1,366 EM orders that satisfied all of the preceding criteria.

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[43] EMS Capita during the study's time period.

[44] These eligibility criteria of the AC Project's 12 month+ cohort were applied to all EM orders bearing an "Acquisitive Crime" classification because it is known that there was a sizeable proportion of wrongful enrolments in the project.

[45] In line with the intention-to-treat principle.

An individual's police force area of residence at the point of release from prison, as recorded by nDelius, was then used to derive the treatment and comparison groups.[46]

Specifically, members of the treatment group had to have a recorded residence at the point of prison release that was in one of the participating police force areas. In contrast, members of the comparison group had to have a recorded prison release location in one of the non-participating police force areas.

Analysis of the two groups at this stage revealed that there were 39 members of the AC 12 month+ cohort treatment group whose recorded PDU related to a non-participating police force area. This subgroup was therefore excluded, which left 1,327 members of the treatment group (i.e., EM orders that met all eligibility criteria).

With regard to the comparison group, there were 3,668 members who satisfied all of the criteria, which for this group also excluded any individual whose prison release reason was recorded as death or deportation from the United Kingdom.

The combined groups therefore amounted to 4,995 members in total.

Covariates

Propensity Score Matching (PSM) was employed in relation to each of the three intermediate outcomes within 12 months of release from prison or up to the sentence expiry date, whichever was earlier. The selected covariates were the protected characteristics and criminogenic factors that were recorded for each member of the treatment and comparison groups.

While there is published research on the influence of an individual's demographic characteristics on their journey through the criminal justice system – notably age, ethnicity, sex and criminal history – there is less material specifically on the factors influencing recall to prison, licence breach or general probationary compliance (e.g., HM Prison and Probation service, 2018; Farrington et al. 2006; Ray, 2019).

[46] The was determined by the reported Probation Delivery Unit (PDU) on release, which was assigned to one of the 43 territorial police force areas of England and Wales.

For instance, the current guidance on recall for probation practitioners is contained in the "Recall, Review and Re-Release of Recalled Prisoners Policy Framework", which took effect in 2019.[47] This states in section 4.3 that recall must be considered in respect of a prison leaver released on licence after serving a standard determinate sentence where:

- they have breached a specific condition of their licence;
- either the behaviour being exhibited or their change in circumstances means that the risk posed is assessed as no longer safely manageable in the community; or
- contact between the prison leaver and their probation practitioner has broken down.

Separately, although not specific to standard determinate sentenced prison leavers, HM Inspectorate of Probation published, "A thematic inspection of imprisonment for public protection (IPP) recall decisions", in 2023.[48] This found that there was a number of common factors associated with a decision to recall to prison in the cases examined, such as:

- increased substance misuse;
- deterioration of mental health;
- disclosure of inappropriate sexual thoughts or feelings;
- disclosure of thoughts of offending;
- police intelligence that indicated increasing risk;
- rumination and grievance thinking, which was seen as a risk factor; and/or
- risk of domestic abuse in a deteriorating relationship.

Given the available research conclusions, 22 variables in addition to a treatment group variable were selected on the grounds that they could be expected to affect the prison leaver's post-release intermediate outcomes while being managed in the community on licence.[49]

47 https://www.gov.uk/government/publications/recall-review-and-re-release-of-recalled-prisoners
48 https://www.justiceinspectorates.gov.uk/hmiprobation/inspections/ipp-recall-thematic/
49 All numerical discrete variables were converted into factors for assessment purposes within R.

The following table summarises the potential covariates of the three intermediate outcomes within 12 months of release, each of which were extracted or derived from the MoJ's P-NOMIS, nDelius and OASys databases.

Variable	Values	Meaning
Treatment	1 = Comparison group 2 = Treatment group	Membership of pilot or non-pilot group
HDC	1 = Yes 2 = No	Released early from prison on Home Detention Curfew, which is a form of EM
Index offence type	1 = Theft 2 = Robbery	Acquisitive principal offence type
Custodial sentence length	Number of months	Total duration of custody imposed by sentencer
Release year	1 = 2021 2 = 2022 3 = 2023	Calendar year of release from prison
Prior CJS disposals	Non-negative integer	Count of previous disposals since 2010 that were subject to offender management by the Probation Service
Sex	1 = Male 2 = Female	Legal sex recorded
Ethnicity	1 = White 2 = Non-White	High level ethnic group recorded
British citizen	1 = Yes 2 = No	UK or non-UK nationality
Age at release	Number of years	Whole number of years between birth and prison release
Disability at release	1 = No 2 = Yes	Disability status recorded at point of release
OASys General reoffending Predictor (OGP), 1 year	Integer between 1 and 100	Likelihood of non-sexual and non-violent proven reoffending within 1 year
OASys Violence predictor (OVP), 1 year	Integer between 1 and 100	Likelihood of non-sexual and violent proven reoffending within 1 year
Risk of Serious Recidivism (RSR)	Percentage between 0 and 100	Likelihood of committing a serious reoffence within 2 years

Variable	Values	Meaning
Risk of Serious Harm (ROSH)	1 = “Low” 2 = “Medium” 3 = “High” or “Very high”	Likelihood band that a future offence will be one from which a victim would be unlikely to recover[50]
Relationship need	1 = No need identified 2 = Overall need identified	Family, childhood experience, partner and/or previous close relationship problems
Accommodation need	1 = No need identified 2 = Overall need identified	Suitable, permanent housing and/or appropriate location
Employment need	1 = No need identified 2 = Overall need identified	Unemployed, problems with historic employment, work skills and/or attitudes to work
Lifestyle & associates need	1 = No need identified 2 = Overall need identified	Current activities, criminal associates and/or risk-taking behaviour
Alcohol misuse need	1 = No need identified 2 = Overall need identified	Current problem, past use, past frequency and/or motivation to tackle
Drugs misuse need	1 = No need identified 2 = Overall need identified	Current problem, frequency, injecting drugs, motivation to tackle and/or major activity
Thinking & behaviour need	1 = No need identified 2 = Overall need identified	Understand consequences, problem-solving skills, recognise problems and/or understanding others’ views
Attitudes need	1 = No need identified 2 = Overall need identified	Pro-criminal attitudes, attitude to supervision, attitude to wider society and/or motivation to reduce offending

The identification of an “overall need” within each of the eight criminogenic factors was based on the numerical scores from a selection of questions within the Offender Assessment System[51] (OASys), where recorded. This entailed meeting a minimum numerical threshold for one of the specific questions for the accommodation criminogenic

50 https://assets.publishing.service.gov.uk/media/652cf8c9697260000dccf834/Risk_of_Serious_Harm_Guidance_v3.pdf

51 https://assets.publishing.service.gov.uk/media/5a7f676fed915d74e33f6380/research-analysis-offender-assessment-system.pdf

factor or meeting a minimum numerical threshold across the summed scores of all of the questions selected within the factor.[52] A summary of the recorded criminogenic factors among the members of the matched treatment and comparison groups is available in Appendix E.

The Offender Group Reconviction Scale (OGRS) estimate was not chosen as a prospective explanatory variable because it is based on a number of static factors that are already represented by other selected variables.

Sample size remaining

The available OASys records, some of which were incomplete, were linked to the 4,995 members of the combined treatment and comparison groups on the basis of PNC numbers, where the date of the offender's assessment was no more than 365 days before or 30 days after the closest recorded prison release date.[53]

The data linking with OASys records resulted in a dataset of 4,280 members for recall and licence breach formal warnings, of which 1,139 (27%) were in the treatment group and 3,141 (73%) were in the comparison group.[54] This represented an overall linkage rate of 86 per cent with respect to these two intermediate outcomes.

In terms of the probationary compliance rate, all recorded compliance episodes at the individual level were captured within 12 months of release or the sentence expiry date, whichever was earlier. Treatment and comparison group members who had fewer than five episodes in total were excluded.[55] The remaining members' compliance rates were then estimated.

This restriction and the data linking with OASys records resulted in a dataset of 4,103 members for the probationary compliance rate, of which 1,112 (27%) were in the treatment

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[52] Thresholds were used in accordance with the methodology outlined in https://www.gov.uk/government/statistics/identified-needs-of-offenders-in-custody-and-the-community-from-the-offender-assessment-system-30-june-2021/identified-needs-of-offenders-in-custody-and-the-community-from-the-offender-assessment-system-30-june-2021

[53] This date range was to ensure that the assessment's findings were "current" in that they were not too far in the past and they were not materially affected by any post-release developments.

[54] As previously noted, some of the members of the project's treatment and comparison groups were released on HDC.

[55] This exclusion was to ensure that each "yes" outcome in relation to a compliance episode did not represent more than 20 percentage points within the individual's overall probationary compliance rate.

group and 2,991 (73%) were in the comparison group.[54] This represented an overall linkage rate of 82 per cent.

After linking all 23 variables (including the treatment group variable) to members of the treatment and comparison groups, it was found that many of the members lacked a complete set of values, typically in terms of OASys variables. Those members with an incomplete set of values were therefore excluded from the groups.

This exclusion left a remaining sample size of 2,587 members for the recalls and licence breach warnings, of which 638 (25%) were in the treatment group and 1,949 (75%) were in the comparison group. After taking account of missing values, the overall linkage rate was 52 per cent.

With regard to the probationary compliance rate, there were 2,476 members remaining, of which 621 (25%) were in the treatment group and 1,855 (75%) were in the comparison group. After taking account of missing values, the overall linkage rate was 50 per cent.

The tables below show the distributions of selected protected characteristics among the three intermediate outcome variables where members were included within and excluded from the treatment group due to the completeness of available data.

Recalls and warnings	Excluded from treatment group (n=501)	Included in treatment group (n=638)	p-value
Sex: Male	94%	95%	0.33
Sex: Female	6%	5%	0.33
Ethnicity: White	64%	83%	<0.01
Ethnicity: Not White	36%	17%	<0.01
Nationality: British	92%	96%	<0.01
Nationality: Not British	8%	4%	<0.01
Custodial sentence length: <= 2 years	15%	8%	<0.01
Custodial sentence length: >2 years & <= 4 years	34%	40%	0.03

Recalls and warnings	Excluded from treatment group (n=501)	Included in treatment group (n=638)	p-value
Custodial sentence length: >4 years & <= 10 years	41%	45%	0.18
Custodial sentence length: >10 years	10%	6%	0.02

Compliance	Excluded from treatment group (n=491)	Included in treatment group (n=621)	p-value
Sex: Male	94%	95%	0.29
Sex: Female	6%	5%	0.29
Ethnicity: White	64%	83%	<0.01
Ethnicity: Not White	36%	17%	<0.01
Nationality: British	92%	96%	<0.01
Nationality: Not British	8%	4%	<0.01
Custodial sentence length: <= 2 years	15%	8%	<0.01
Custodial sentence length: > 2 years & <= 4 years	34%	41%	0.03
Custodial sentence length: > 4 years & <= 10 years	41%	45%	0.20
Custodial sentence length: > 10 years	10%	6%	0.02

One can see that all of the percentage point differences were statistically significant ($p<0.05$), except for sex and custodial lengths of between four and ten years.

Use of PSM

Nearest neighbour[56] matching, optimal[57] matching and full matching without replacement were all conducted so as to investigate which PSM method produced the best overall balance. An acceptable balance was determined when the standardised mean differences fell between -0.1 and +0.1 and the variance ratios lay between 0.80 and 1.25.

Nearest neighbour matching was found to deliver the most balanced sample for the recall, formal warnings for licence breach and probationary compliance intermediate outcomes.

With regard to the likelihood of recall, 626 treatment group members were matched to 626 comparison group members. The absolute standardised mean difference between the matched treated and comparison groups was almost 0.003, which indicates that a good quality of matching was achieved. There were three variables with an absolute mean difference between 0.05 and 0.10. These were length in months, sex and ROSH.

In terms of the number of formal warnings for licence breach, 626 treatment group members were matched to 626 comparison group members. The overall standardised mean difference between the matched treated and comparison groups was almost 0.003, which indicates that a good quality of matching was achieved. There were three variables with an absolute mean difference between 0.05 and 0.10. These were length in months, sex and ROSH.

With respect to the overall rate of probationary compliance, 611 treatment group members were matched to 611 comparison group members. The absolute standardised mean difference between the matched treated and comparison groups was 0.003, which indicates that a good quality of matching was achieved. There were six variables with an absolute mean difference between 0.05 and 0.10. These were offence type, sex, RSR percentage, ROSH, accommodation need and thinking and behaviour need.

Sensitivity analysis

Given the considerable reduction in the combined treatment and comparison sample size from 4,995 to 2,587 members before the application of PSM, a sensitivity analysis was

[56] On a 1:1 basis.

[57] On a 2:1 basis.

undertaken that omitted the use of any linked OASys records, which was the most important reason for the reduction.

Restricting the assessment of the intermediate outcomes to the 12 non-OASys variables[58] only reduced the combined sample size to 4,986 members with a complete set of values, which represented an overall linkage rate of almost 100 per cent in terms of the recall and formal warnings for licence breach intermediate outcomes. This was composed of 1,325 members in the treatment group (27%) and 3,661 members of the comparison group (73%) before PSM.

The application of PSM[59] left 1,306 members of the treatment group and 1,306 members of the comparison group, which represented 2,612 members overall, for these two intermediate outcomes.

With regard to the probationary compliance rate, the use of the 12 non-OASys variables reduced the combined sample size to 4,761 members with a complete set of values, which was equivalent to an overall linkage rate of 96 per cent. This was made up of 1,294 members in the treatment group (27%) and 3,467 members of the comparison group (73%) before PSM.

The application of PSM[59] left 1,270 members of the treatment group and 1,270 members of the comparison group, which represented 2,540 members overall, for this intermediate outcome.

[58] Treatment group; Home Detention Curfew (HDC); Offence type; Custodial sentence length; Release year; Number of previous CJS disposals; Sex; Ethnicity; British nationality; Age at release; Disability reported at release; and Risk of Serious Harm (RoSH).

[59] Nearest Neighbour Matching without replacement on a 1:1 basis.

Appendix E: Distribution of criminogenic factors

Distribution by identified need

The table below summarises the estimated proportions of identified "need" among the matched treatment and comparison groups in terms of each of the eight criminogenic factors recorded within the MoJ's OASys management information system.

Identified need	Treatment group (n=626)	Comparison group (n=626)
Accommodation	391 (62%)	394 (63%)
Alcohol misuse	207 (33%)	202 (32%)
Attitudes	571 (91%)	573 (92%)
Drug misuse	464 (74%)	454 (73%)
Employability	527 (84%)	520 (83%)
Lifestyle & associates	615 (98%)	531 (85%)
Relationships	524 (84%)	531 (85%)
Thinking & behaviour	537 (86%)	543 (87%)

In general, large shares of both groups had an identified need across seven of the eight criminogenic categories. Only alcohol misuse was below 50 per cent, although it still affected a significant minority of each group.

The three highest rates of need among the treatment group were found in:

- lifestyle and associates – risky behaviour, being influenced by criminal peers;
- attitudes – views on supervision and on wider society, pro-criminal attitudes, motivation to reduce offending; and
- thinking and behaviour – awareness of consequences, understanding of others' views, impulsivity.

Distribution by count of identified needs

The following table summarises the total estimated number of identified criminogenic factors in each of the matched groups.

Number of needs identified	Treatment group (n=626)	Comparison group (n=626)
0	0 (0%)	0 (0%)
1	1 (<1%)	3 (<1%)
2	13 (2%)	10 (2%)
3	26 (4%)	25 (4%)
4	46 (7%)	52 (8%)
5	107 (17%)	89 (14%)
6	133 (21%)	148 (24%)
7	186 (30%)	196 (31%)
8	114 (18%)	103 (16%)
TOTAL	**626 (100%)**	**626 (100%)**

There were no members of either group who did not have at least one identified need, and under one per cent of either group had just one need. In contrast, 16-18 per cent had identified needs across all of the criminogenic factors.

The median number of needs within each group was six. The mean number of needs was 6.1.

OASys coverage of offenders

The most recent figures on the proportions of offenders who received an OASys “Layer 3” assessment were published in 2019 and relate to outturns as of June 2018.[60]

The table below shows that a clear majority of offenders serving a custodial sentence received an assessment, and they were generally more likely to have done so than offenders in receipt of a community sentence.

[60] https://www.gov.uk/government/statistics/identified-needs-of-offenders-in-custody-and-the-community-from-oasys

Category	Coverage
Custody: >12m and <4 years	65%
Custody: 4 years	70%
Custody: >4 years and <=10 years	77%
Custody: >10 years and <Life	83%
Custody: all	78%
Community orders: all	46%
Suspended sentence orders: all	53%

Appendix F: Recall to prison

Recall rate

The rate of recall was defined as the proportion of the treatment and comparison groups who were recalled to prison post-release, as recorded by the existence of a recall date on nDelius. The time period was restricted to the first 12 month of release from prison or the sentence expiry date recorded, whichever was earlier, among AC eligible prison leavers released up to 30 September 2023.

"Empty" model of PSM sample

The following table compares the 12 month recall rates of the two groups among the matched treatment and comparison groups of the 12 month+ cohort. The associated p-value is also provided, which was based on a two proportion Z-test.

Recall rate	Treatment group (n=626)	Comparison group (n=626)	p-value
Estimate	62.6%	62.0%	0.82

The difference between the matched groups' estimated rates of recall to prison was not statistically significant.

Logistic regression

A logistic regression is used in statistics to predict the likelihood of a binary event based on a number of explanatory variables. Algebraically, this type of regression takes the form of:

$$log\ [\ P(E)\ /\ (1\ -\ P(E))\ ]\ =\ \beta_0\ +\ \beta_1 X_1\ +\ \beta_2 X_2\ +\ \ldots\ +\ \beta_n X_n$$

where:

- P(E) is the probability of event E, such that $0 \leq P(E) \leq 1$;
- X_i is the i^{th} explanatory variable, where i = 1, 2, 3, …, n; and
- β_j is the coefficient estimate of the j^{th} explanatory variable, where j = 0, 1, 2, …, n.

In short, a logistic regression estimates the "log-odds" of a discrete event that can only be one of two outcomes.

For example, in terms of a probabilistic binary outcome such as whether it rains or not, there is the likelihood of "success" (say, 0.8 probability of rain) and a corresponding likelihood of "failure" (say, 0.2 probability of no rain).

The odds are therefore: 0.8/0.2 = 4 to 1; and the log-odds are: ln(4) = 1.39.

In this study a logistic regression was employed to determine whether enrolment in the AC Project significantly influenced the likelihood of a prison leaver on licence being recalled to prison within 12 months of release. The other explanatory variables were recorded criminogenic factors.

"Full" model assumptions and testing

The use of logistic regression rests on a number of key assumptions.

i. The dependent variable is binary – e.g., whether a prison leaver released on licence has been recalled within 12 months.
ii. Each observation is independent. It is logical that the likelihood of any individual prison leaver being recalled to prison does not influence the probability of that outcome among other prison leavers.[61]
iii. There is no serious multicollinearity. A Variance Inflation Factor (VIF) test confirmed that none of the selected covariates was strongly correlated with each other.[62]
iv. There are no influential outliers. The Cook's Distance test was employed to identify any such outliers. It was found that removing the identified outliers did not influence that statistical significance of the treatment group variable, so all observations were retained.

[61] Separately, de-duplication checks took place to ensure that the dataset contained only unique prisoner releases and that each one was only represented in either the treatment or comparison group.

[62] Although the VIF test is commonly recognised as the standard statistical test for the presence of multicollinearity, its usefulness has recently been questioned by Salmerón-Gómez et al. (2025), not least in the presence of binary variables. The authors put forward a "redefined variance inflation factor" test as an alternative. Given the current novelty of this prospective approach, it is not explored further in this evaluation.

v. There is a linear relationship between the continuous explanatory variables and the log-odds outcome variable. Results from a Box-Tidwell test indicated that the continuous explanatory variables met this assumption.

vi. The sample size is sufficiently large. This was achieved, given the 23 remaining explanatory variables and the lowest probability of the binary outcome variable.[63]

"Full" model results of PSM sample

The following table summarises the results of the logistic regression of the likelihood of being recalled to prison. The data were composed of the matched treatment and comparison groups, in which 12 of the remaining 638 members of the treatment group were unmatched.

Variable	Coefficient	Standard error	p-value
Intercept	-2.396	0.768	0.002**
Treatment	0.030	0.126	0.810
HDC	-0.258	0.204	0.206
Offence type	0.308	0.203	0.129
Custodial sentence length	-0.001	0.002	0.766
Release year 2022	-0.199	0.171	0.244
Release year 2023	-0.096	0.178	0.589
Previous CJS disposals	0.019	0.014	0.182
Sex	0.716	0.354	0.043*
Ethnicity	-0.179	0.182	0.326
British	0.581	0.381	0.127
Age at release	-0.004	0.009	0.619
Disability reported at release	-0.070	0.130	0.590
OGP year 1	0.022	0.007	0.001**
OVP year 1	0.018	0.008	0.027*
RSR	0.006	0.050	0.906

[63] While sample size calculation for logistic regression is a complex issue, the work of Peduzzi et al. (1996) suggested the following guideline for a minimum number of cases. Let *p* be the smallest of the proportions of negative or positive outcomes in the sample and *k* the number of explanatory variables, then the minimum number of cases to have is: N = 10 * k / p. This rule therefore indicates that the minimum N = 10 * 25 / 0.377 = 663.

Variable	Coefficient	Standard error	p-value
Accommodation need	0.058	0.142	0.684
Alcohol need	0.021	0.157	0.895
Attitude need	0.060	0.239	0.802
Drugs need	-0.153	0.163	0.350
Employment need	0.279	0.180	0.121
Lifestyle need	0.097	0.502	0.847
Relationship need	0.320	0.178	0.073
Thinking & behaviour need	0.169	0.190	0.374
Rosh medium	0.813	0.495	0.100
Rosh high/v.high	0.921	0.514	0.073

Significance codes: *** p<0.001; ** 0.001 ≤ p < 0.010; * 0.010 ≤ p < 0.050

(Dispersion parameter for binomial family taken to be 1)

Null deviance: 1659.1 on 1251 degrees of freedom

Residual deviance: 1478.5 on 1226 degrees of freedom

AIC: 1530.5

Number of Fisher Scoring iterations: 4

McFadden pseudo R^2 = 0.109

Estimated Average Marginal Effect of treatment group membership:

Variable	AME	Standard error	p-value
Treatment	0.006	0.026	0.810

Sensitivity analysis

Conducting the PSM exercise without any OASys records produced a larger combined matched sample of 2,612 members in total. However, this did not alter the overall finding.

Estimated Average Marginal Effect of treatment group membership:

Variable	AME	Standard error	p-value
Treatment	-0.020	0.018	0.270

Conclusion

The results indicated that enrolment in the AC Project's 12 month+ cohort did not have a significant effect on the likelihood of recall to prison within 12 months, other things being equal over the study period.

Appendix G: Formal warnings for licence breach

Count of warnings

The number of formal warnings given to the members of the treatment and comparison groups for a licence breach was estimated on the basis of the number of warning letters sent by probation practitioners in respect of a confirmed licence breach, as recorded on nDelius.[64] Specifically, the selected "Breach Action" variables in nDelius were:

- AWLI – First warning letter sent
- AWL2 – Second warning letter sent
- AWLF – Final warning letter sent
- C039 – Other enforcement letter sent
- C366 – Confirmation Warning Letter Sent
- CLBR – Breach Letter Sent

The time period was restricted to the first 12 month of release from prison or the sentence expiry date recorded, whichever was earlier, among AC eligible prison leavers released up to 30 September 2023.

"Empty" model of PSM sample

The following table compares the average number of formal warnings for licence breach between the two groups among the matched sample. The associated p-value is also provided, as estimated on the basis of a Welch's t-test.

Average number of warnings	Treatment group (n=626)	Comparison group (n=626)	p-value
Estimate	0.57	0.59	0.73

[64] There is no single variable within nDelius that records the existence of a prison leaver's licence breach, which is determined by probation practitioners.

The difference between the matched groups' average number of formal warnings was not statistically significant.

Distribution of warnings

The table below summarises the frequency of formal warnings for licence breach among the matched groups, as recorded in nDelius. The estimated percentages are rounded to the nearest one per cent, so these totals do not always sum to 100 per cent.

Number of warnings	Treatment group (n=626)	Comparison group (n=626)
0	434 (69%)	420 (67%)
1	105 (17%)	126 (20%)
2	43 (7%)	40 (6%)
3	29 (5%)	17 (3%)
4	8 (1%)	9 (1%)
5+	7 (1%)	14 (2%)
TOTAL	**626 (100%)**	**626 (100%)**

The minimum and median number of formal warnings was zero within each group. The maximum number of formal warnings recorded for any member of the treatment group was eight in the treatment group and nine in the comparison group. It is evident that the two distributions were quite similar.

Background to regression analysis

There are two types of regressions that are appropriate to use when seeking to represent an outcome variable that is characterised by a discrete count (e.g., number of people or instances): a Poisson regression; and a negative binomial regression.

Essentially, a Poisson regression is suitable when the mean and the variance of the outcome variable are approximately equal.

In contrast, a negative binomial regression is suitable when the variance of the outcome variable is appreciably larger than its mean.

Overdispersion

A qualification to the above rules is when the outcome variable is subject to "over-dispersion". This occurs when there is greater variability in a dataset than would be expected based on an assumed type of distribution.

In addition, real world count data are sometimes "zero-inflated" – namely, there is a large share of zero values among the data.

One cause is the presence of unobserved heterogeneity, where different subgroups within the cohort exhibit varying behaviours that are not captured in a statistical model. This effectively results in a two stage process, whereby the first stage is responsible for the binary outcome (e.g., visit or do not visit a doctor during a year) and then a second stage generates the frequency of the outcomes (e.g., the number of visits to a doctor during a year) with respect to a given individual.

However, it is not necessarily the case that a large share of zero values in the outcome variable is the product of different subgroups who have distinctive patterns of behaviour. For instance, the presence of "excess" zeros could be explained by other model variables, such as the theta parameter in the negative binomial regression.[65]

Application to the AC Project

A dispersion test based on the "AER" package in R confirmed that the formal warnings outcome variable was overdispersed (dispersion = 2.01, $p<0.01$).

There is no *a priori* expectation that zero values were occurring due to a two stage process. Moreover, zero-inflation tests on stimulated residuals of the negative binomial regression model, conducted with the "DHARMa" package in R, confirmed that zero-inflation was not present ($p = 0.96$).

[65] The theta parameter is a measure of the degree of dispersion.

Due to the overdispersion in the outcome variable, a negative binomial regression and a quasi-Poisson regression[66] were both chosen to examine the relationship between the number of formal warnings issued and the selection of covariates set out in Appendix D.

Key assumptions for both tests are the same – i.e., existence of count data, presence of overdispersion and no covariates are strongly correlated. All assumptions were met.

"Full" model results of PSM sample

The following tables summarise the results of the regressions based on the matched treatment and comparison groups, in which 12 of the remaining 638 members of the treatment group were unmatched.

Negative binomial regression (NBR)

Variable	Coefficient	Standard error	p-value
Intercept	-0.364	0.768	0.635
Treatment	-0.067	0.107	0.533
HDC	-0.385	0.166	0.020*
Offence type	0.153	0.171	0.371
Custodial sentence length	-0.001	0.002	0.626
Release year 2022	-0.487	0.134	<0.001***
Release year 2023	-0.761	0.146	<0.001***
Previous CJS disposals	0.004	0.010	0.705
Sex	-0.313	0.294	0.286
Ethnicity	0.094	0.155	0.545
British	-0.569	0.350	0.104
Age at release	-0.020	0.008	0.010**
Disability reported at release	-0.140	0.110	0.206
OGP year 1	0.003	0.006	0.535

[66] According to Ver Hoef and Boveng (2007): "The variance of a quasi-Poisson model is a linear function of the mean while the variance of a negative binomial model is a quadratic function of the mean. These variance relationships affect the weights in the iteratively weighted least-squares algorithm of fitting models to data. Because the variance is a function of the mean, large and small counts get weighted differently in quasi-Poisson and negative binomial regression." (https://esajournals.onlinelibrary.wiley.com/doi/10.1890/07-0043.1)

Variable	Coefficient	Standard error	p-value
OVP year 1	-0.011	0.007	0.112
RSR	0.015	0.038	0.699
Accommodation need	-0.125	0.123	0.309
Alcohol need	0.055	0.131	0.673
Attitude need	0.659	0.233	0.005**
Drugs need	0.297	0.147	0.043*
Employment need	-0.041	0.160	0.801
Lifestyle need	0.822	0.594	0.166
Relationship need	-0.072	0.156	0.643
Thinking & behaviour need	0.037	0.171	0.827
Rosh medium	-0.009	0.412	0.983
Rosh high/v.high	-0.193	0.432	0.655

Significance codes: *** p<0.001; ** 0.001 ≤ p < 0.010; * 0.010 ≤ p < 0.050

(Dispersion parameter for Negative Binomial(0.5938) family taken to be 1)

Null deviance: 1030.25 on 1251 degrees of freedom

Residual deviance: 956.05 on 1226 degrees of freedom

AIC: 2548.9

Number of Fisher Scoring iterations: 1

Theta: 0.5938

Std. Err.: 0.0674

2 x log-likelihood: -2494.8720

Estimated Average Marginal Effect of treatment group membership (NBR):

Variable	AME	Standard error	p-value
Treatment	-0.039	0.063	0.534

Quasi-Poisson regression

Variable	Coefficient	Standard error	p-value
Intercept	-0.398	0.812	0.624
Treatment	-0.050	0.108	0.645
HDC	-0.404	0.157	0.010*
Offence type	0.216	0.173	0.214
Custodial sentence length	-0.001	0.002	0.711
Release year 2022	-0.461	0.127	<0.001***
Release year 2023	-0.719	0.144	<0.001***
Previous CJS disposals	0.005	0.010	0.626
Sex	-0.351	0.310	0.258
Ethnicity	0.099	0.151	0.512
British	-0.637	0.386	0.099
Age at release	-0.016	0.008	0.043*
Disability reported at release	-0.169	0.110	0.127
OGP year 1	0.004	0.006	0.436
OVP year 1	-0.010	0.007	0.148
RSR	0.008	0.039	0.830
Accommodation need	-0.120	0.122	0.325
Alcohol need	0.055	0.130	0.669
Attitude need	0.635	0.251	0.012*
Drugs need	0.265	0.151	0.081
Employment need	-0.024	0.161	0.879
Lifestyle need	0.706	0.655	0.281
Relationship need	-0.019	0.154	0.900
Thinking & behaviour need	0.015	0.170	0.929
Rosh medium	-0.132	0.388	0.734
Rosh high/v.high	-0.295	0.409	0.470

Significance codes: *** p<0.001; ** 0.001 ≤ p < 0.010; * 0.010 ≤ p < 0.050

(Dispersion parameter for Quasi-Poisson family taken to be 2.072405)

Null deviance: 1961.8 on 1251 degrees of freedom
Residual deviance: 1819.0 on 1226 degrees of freedom
AIC: N/A
Number of Fisher Scoring iterations: 6

Estimated Average Marginal Effect of treatment group membership:

Variable	AME	Standard error	p-value
Treatment	-0.029	0.063	0.645

Sensitivity analysis

Conducting the PSM exercise without any OASys records produced a larger combined sample of 2,612 members in total. However, this did not alter the overall finding.

Estimated Average Marginal Effect of treatment group membership (NBR):

Variable	AME	Standard error	p-value
Treatment	0.057	0.044	0.201

Conclusion

The results indicate that enrolment in the AC Project's 12 month+ did not have a significant effect on the number of formal warnings for a licence breach, other things being equal over the study period. Moreover, both regression models have similar coefficient estimates and have almost the same range of variables that are individually significant.

Appendix H: Overall compliance

Compliance count

Overall probationary compliance was defined as the proportion of "contact type" events that had an explicit "yes" outcome among all yes/no events recorded on nDelius with respect to individual members of the treatment and comparison groups. The seven most common broad types of compliance event recorded were:

- all initial appointments with a probation practitioner;
- planned office visits with a probation practitioner (excluding initial appointments);
- other planned contacts by a probation practitioner (excluding initial appointments);
- drug/alcohol tests or related appointments;
- Approved Premises contacts (excluding drug/alcohol testing);
- appointments with Commissioned Rehabilitative Services (CRS); and
- Integrated Offender Management (IOM) contacts.

The time period was restricted to the first 12 months following release from prison or the sentence expiry date recorded, whichever was earlier, among AC eligible prison leavers released up to 30 September 2023.

"Empty" model of PSM sample

The following table compares the average probationary compliance rate across individuals between the two groups. The associated p-value is also provided, which is based on a Welch's t-test.

Average compliance rate	Treatment group (n=611)	Comparison group (n=611)	p-value
Estimate	81.0%	81.2%	0.83

The difference between the matched groups' average probationary compliance rates was not statistically significant.

Distribution of compliance rates

The table below summarises the frequency of individual probationary compliance rates among the matched groups, as recorded in nDelius. The estimated percentages are rounded to the nearest one per cent, so these totals do not always sum to 100 per cent.

Compliance rate	Treatment group (n=611)	Comparison group (n=611)
<=30%	5 (1%)	5 (1%)
>30% and <=40%	8 (1%)	8 (1%)
>40% and <=50%	26 (4%)	36 (6%)
>50% and <=60%	37 (6%)	21 (3%)
>60% and <=70%	68 (11%)	58 (9%)
>70% and <=80%	100 (16%)	115 (19%)
>80% and <=90%	150 (25%)	142 (23%)
>90%	217 (36%)	226 (37%)
TOTAL	**611 (100%)**	**611 (100%)**

The minimum estimated compliance rate was 14 per cent within the treatment group and 20 per cent within the comparison group. The respective estimated medians were both 85 per cent, while the respective estimated maximum compliance rates were both 100 per cent. It is evident that the two distributions were quite similar.

Beta regression

The outcome variable in this case is an individual's compliance rate, which is a bounded value that lies within the interval of (0,1). Consequently, a beta regression is the most appropriate approach because it captures modelled outcomes that are defined as proportions or rates, such as the share of a cohort exhibiting a certain behaviour.

Unlike a conventional linear regression, which can predict values outside the interval of (0,1), a beta regression ensures that predictions remain within the valid bounds.

Interpreting beta regression coefficients

The coefficients obtained from a beta regression model represent the change in the log-odds of the outcome variable for a one unit change in an explanatory variable, holding all

other variables constant. Consequently, a positive coefficient indicates that the expected proportion represented by the outcome variable increases as the explanatory variable increases, while a negative coefficient suggests the opposite.

Application to the AC Project

The estimated compliance rate of each member of the AC 12 month+ treatment and comparison groups was assessed using a beta regression, where there were at least five compliance events of any kind recorded so as to provide a meaningful individual estimated rate of compliance.

However, a limitation of a beta regression is that it cannot handle values that are exactly 0.000 or 1.000 because they lie outside of the relevant distribution.

Although there were no zero values among the estimated compliance rate at an individual level, about 15 per cent of the values among this outcome variable were 1.000.

One response to this problem is to transform the data. Each individual estimated rate of compliance was adjusted according to the formula recommended by Smithson and Verkuilen (2006):

$$x' = \frac{x(N-1)+S}{N}$$

where x is the unadjusted value of the variable, x' is the adjusted value, N is the sample size and S is a constant number between zero and one; the mid-point of 0.5 was chosen as an appropriate value of S. Consequently, in practical terms, the estimate employed was not materially different from 1.000, but it still lay within the required (0,1) interval. The other estimates of each individual's compliance rate were not materially different either.

Full Model assumptions and testing

The use of Beta regression relies on a number of assumptions:

- The outcome variable exceeds 0.000 and is less than 1.000. The transformed compliance rate satisfies this requirement.

- There is no heteroscedasticity.[67] A Breusch-Pagan test indicated that heteroscedasticity was present ($p<0.01$). It was established that the precision parameter (phi) depended on the release year variable, so this was added to the model specification.
- Each observation is independent. It is logical that the compliance rate of any prison leaver does not influence the probability of that outcome among other prison leavers.
- There is no serious multicollinearity. A Variance Inflation Factor test was conducted, which indicated that this assumption was met (i.e., VIF < 5).

"Full" model results of PSM sample

The following table summarises the results of the beta regression based on the matched treatment and comparison groups, in which 10 of the remaining 621 members of the treatment group were unmatched.

Variable	Coefficient	Standard error	p-value
Intercept	2.941	0.329	<0.001***
Treatment	0.042	0.056	0.453
HDC	-0.056	0.094	0.554
Offence type	-0.209	0.088	0.018*
Custodial sentence length	0.001	0.001	0.260
Release year 2022	-0.149	0.099	0.132
Release year 2023	-0.323	0.099	0.001**
Previous CJS disposals	0.010	0.005	0.067
Sex	-0.361	0.132	0.006**
Ethnicity	0.040	0.082	0.626
British	0.271	0.161	0.093
Age at release	0.004	0.004	0.244
Disability reported at release	-0.125	0.058	0.031*
OGP year 1	-0.015	0.003	<0.001***
OVP year 1	-0.002	0.003	0.546

[67] An unequal variance across the residuals (i.e., the difference between the actual and predicted values of the dependent variable) within a regression.

Variable	Coefficient	Standard error	p-value
RSR	0.008	0.020	0.690
Accommodation need	-0.178	0.065	0.006**
Alcohol need	0.045	0.069	0.518
Attitude need	-0.181	0.112	0.105
Drugs need	0.023	0.074	0.753
Employment need	-0.111	0.087	0.202
Lifestyle need	0.096	0.223	0.668
Relationship need	-0.001	0.083	0.995
Thinking and behaviour need	-0.169	0.087	0.053
Rosh medium	0.013	0.218	0.951
Rosh high/v.high	-0.298	0.227	0.190

Significance codes: *** p<0.001; ** 0.001 ≤ p < 0.010; * 0.010 ≤ p < 0.050

Phi coefficients (precision model with log link):

Variable	Estimate	Standard error	p-value
Intercept	1.140	0.094	<0.001***
Release year 2022	0.132	0.112	0.240
Release year 2023	0.336	0.115	0.004**

Type of estimator: ML (maximum likelihood)
Log-likelihood: 1196 on 29 Df
Pseudo R-squared: 0.150
Number of iterations: 38 (BFGS) + 3 (Fisher scoring)

Estimated Average Marginal Effect on treatment group membership:

Variable	AME	Standard error	p-value
Treatment	0.006	0.008	0.453

Sensitivity analysis

Conducting the PSM exercise without any OASys records produced a larger combined sample of 2,540 members in total. However, this did not alter the overall finding.

Estimated Average Marginal Effect of treatment group membership:

Variable	AME	Standard error	p-value
Treatment	-0.008	0.006	0.165

Conclusion

The results indicate that enrolment in the AC Project's 12 month+ cohort did not have a significant effect on individuals' probationary compliance rates, other things being equal during the study period.

Appendix I: Police arrests avoided

Difference-in-differences (DiD) was used to estimate the number of adult arrests for acquisitive offences that were avoided in England and Wales between 2021/22 and 2023/24 due to the commencement of the AC Project in April 2021.

Background

DiD is a quasi-experimental approach that is intended to estimate the causal effects of an intervention. It does so by comparing actual changes in the treatment group and what would have happened, where the latter is based on trends observed in a comparison group.

Application to AC Project

To derive the DiD estimate, the number of adult arrests for robbery and theft by police force area (PFA) between 2020/21 and 2023/24 inclusive was examined.[68]

The year 2020/21 was employed as the baseline because this was the last full year before the AC Project commenced in April 2021. The outturn number of adult arrests of the 19 participating PFAs was analysed as a block by offence type and compared to the outturns in the 24 police force areas that did not participate in the AC Project.

For simplicity, the later start date of late September 2021 for the 13 PFAs in the second phase of the project was ignored – i.e., an April 2021 start date was effectively assumed for all participating police force areas. This is because the published data on the number of arrests by PFA are only available in periods of financial years, thereby making it difficult to control for sub-annual time periods.

The annual observed percentage change in the number adult arrests for robbery and theft in the 24 non-participating areas were calculated for each year in comparison to 2020/21.

[68] Arrests open data tables, year ending 31 March 2024 (https://www.gov.uk/government/statistics/stop-and-search-arrests-and-mental-health-detentions-march-2024)

This percentage change was then applied to the annual observed number of arrests by offence type for the 19 participating police force areas so as to estimate a counterfactual.

The difference between the observed and counterfactual number of arrests was then calculated for each year and an overall total estimated for the period.

There were two principal adjustments to the published arrest data to account for the AC Project in general and for the 12 month+ cohort more specifically.

Firstly, the annual number of arrests for theft was reduced by 33 per cent. This was because not all theft offences were in scope of the AC Project. The notional adjustment factor was chosen on the basis of MoJ published sentencing figures, which allowed for a more granular disaggregation by sub-offence type over the time period than was possible using published arrest data.[69]

Secondly, the overall DiD estimates for 2022/23 and 2023/24 were reduced by four per cent and 14 per cent respectively. This notional adjustment factor was intended to account for the fact the AC Project's 3-12 month cohort would have represented differing proportions in each year. The percentage adjustments were based on the imputed cohort shares of the annual number of EM AC orders completing in 2022/23 and 2023/24 that resulted in a successful tag installation.

The following tables summarise the aforementioned approach to the DiD analysis.

[69] No adjustment was necessary in relation to robbery.

Estimated number of adult arrests in the 24 non-participating PFAs by offence type and by year

24 PFAs – comparison group			
Offence type	**Year**	**Number of arrests**	**Difference relative to 20/21**
Robbery (no adjustment needed for AC eligibility)	20/21	4,556	
	21/22	4,214	-8%
	22/23	4,623	+1%
	23/24	4,945	+9%
Theft (adjusted for AC eligibility)	20/21	25,528	
	21/22	24,484	-4%
	22/23	28,472	+12%
	23/24	33,287	+30%

Estimated number of adult arrests in the participating PFAs by offence type and by year

19 PFAs – treatment group					
Offence type	**Year**	**Number of arrests**	**Counterfactual number of arrests**	**Annual difference**	**12 month+ difference**
Robbery (no adjustment needed for AC eligibility)	20/21	4,829			
	21/22	4,475	4,467	8	8[70]
	22/23	4,834	4,900	-66	-64[71]
	23/24	5,753	5,241	512	440[72]
Theft (adjusted for AC eligibility)	20/21	27,173			
	21/22	22,830	26,062	-3,233	-3,233[70]
	22/23	23,908	30,306	-6,398	-6,174[71]
	23/24	27,148	35,432	-8,284	-7,124[72]

[70] Only the 12 month+ cohort existed in 2021/22.

[71] Adjustment of four per cent for the addition of the 3-12 month cohort during 2022/23.

[72] Adjustment of 14 per cent for the 3-12 month cohort during 2023/24.

DiD estimated number of arrests avoided due to AC 12 month+ cohort by offence type

21/22-23/24	Robbery	Theft	TOTAL
Both AC cohorts	454	-17,914	**-17,460**
12m+ cohort	385	-16,531	**-16,146**

Conclusion

One can infer that there were in the region of 16,000 fewer adult arrests in total between 2021/22 and 2023/24 across the participating police force areas out of a counterfactual total of some 106,000 arrests as a result of the AC Project's 12 month+ cohort. This reduction was dominated by the estimated decline in the number of adult arrests for theft, which was partly offset by a modest rise in the number of adult arrests for robbery.

Limitations

The main limitations with regard to this DiD approach to estimate the avoided number of arrests are set out below.

- There were not identical trends between the comparison group and the treatment group of PFAs preceding the commencement of the AC Project in April 2021. Between 2017/18 and 2020/21 overall (which is the same number of years as between 2020/21 and 2023/24), the most recent Home Office published data indicate that the total number of adult arrests for robbery in the treatment group PFAs declined by eight per cent, while the corresponding number of arrests in the comparison group PFAs fell by 11 per cent. The published data also show that the number of adult arrests for theft declined by 31 per cent in the treatment group PFAs and by 43 per cent in the comparison group PFAs. Consequently, the DiD parallel trend assumption among adult arrests for theft appears not to have been met as closely as for robbery.
- The use of 2020/21 could be a distorted baseline with regard to the number of adult arrests in either group of PFAs given that the Covid-19 pandemic was unfolding nationally that year.
- The use of MoJ sentencing distributions by offence sub-type to account for the fact that not all theft offences are within the scope of the AC Project may not be a reliable proxy in terms of adult arrests in either group of PFAs.

- The imputed disaggregation of the AC Project's 12 month+ and 3-12 month cohorts may not be an accurate proxy with which to estimate the cohort-specific number of adult arrests for robbery or theft.

The true number of avoided arrests due to the AC Project's 12 month+ cohort may therefore be considerably higher or lower than the overall estimate of some 16,000 between 2021/22 and 2023/24. Caution should therefore be taken when interpreting this tentative estimate.

Appendix J: Avoided reoffences

The estimated distribution of offence types (within the treatment and comparison group constructed for the reoffending analysis) was applied to the approximate 3,360 AC orders involving an EM tag installation that completed between 2021/22 and 2023/24 in the following table. Note that the use of rounding means that the totals may not sum exactly.

Category	Treatment group (n=3,360)	Comparison group (n=3,360)	Difference in reoffending/ reoffences
12 month proven reoffending rate	26.2%	33.2%	-7.0%
Estimated number of reoffenders	880	1,116	-235
Average number of reoffences per offender within 12 months	0.69	1.04	-0.35
Estimated total number of reoffences within 12 months	2,318	3,494	-1,176
of which:			
Theft	898	1,361	-463
Summary non-motoring	375	504	-129
Summary motoring	362	448	-86
Drugs	255	277	-22
Violence against the person	121	222	-101
Miscellaneous crimes against society	107	162	-55
Fraud	67	114	-47
Public order offences	47	80	-33
Possession of weapons	40	188	-148
Robbery	27	132	-105
Criminal damage & arson	20	0	+20
Sexual offences	0	0	0

Assuming that the results of the proven reoffending analysis can be generalised to a broader treatment group over a longer time period, one can infer that the AC Project's 12 month+ cohort up to 2023/24 resulted in around 1,180 fewer proven reoffences, of which about 680 (or 60%) were either theft or summary offence types.

Appendix K: Ethics

The impact evaluation of the AC Project's 12 month+ cohort was conducted in line with the Government Social Research's six ethical principles.[73]

Clear and defined public benefit

The MoJ is committed to assessing the AC Project so as to provide an evidence base that can inform a future Ministerial decision regarding national roll-out. The research team worked with a range of stakeholders to develop the evaluation's objectives.

Sound application, conduct and interpretation

The analytical design of the project's impact evaluation was developed by specialists in the MoJ and subject to internal review prior to commencement. Prior to publication, all results were scrutinised by senior stakeholders and two independent peer reviewers who are academic experts on the criminal justice system.

Data protection

The impact evaluation has adhered to the requirements of the UK General Data Protection Regulations (GDPR) and the Data Protection Act 2018. In particular, this evaluation was conducted under the lawful basis of "public task" which allows the processing of personal data where it is necessary for the performance of a task carried out in the public interest[74] – namely, research to inform a future Ministerial decision regarding national rollout of the AC Project. A Data Protection Impact Assessment was also undertaken as part of the project to ensure that all data procedures were compliant with legal obligations.

Specific and informed consent

Further to the "public task" justification stated above, the formal consent to use subjects' data was not required because the impact evaluation was based on the secondary use of personal data that was originally collected and recorded on Departmental case

[73] https://www.gov.uk/government/publications/ethical-assurance-guidance-for-social-research-in-government

[74] https://uk-gdpr.org/chapter-2-article-6/

management systems, notably nDelius and NOMIS. Such data use for research purposes without obtaining the consent of subjects is permitted by law.

Enabling participation

Given that only secondary data were employed in the impact evaluation, no dedicated recruitment of subjects was undertaken beyond the mandatory enrolment of prison leavers in the AC Project that was required by legislation.

Minimising personal and social harm

All data were suitably anonymised and aggregated in presenting the evaluation conclusions. While criminal behaviour is often considered to be a sensitive topic, no (potential) threats to physical, social or psychological well-being were identified in this evaluation. The findings have been appropriately reported, ensuring transparency on methodological decisions.