The effect of person, treatment and prescriber characteristics on retention in opioid agonist treatment: a 15-year retrospective cohort study

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Abstract

Background and Aims: There is limited evidence on the relationship between retention in opioid agonist treatment for opioid dependence and characteristics of treatment prescribers. This study estimated retention in buprenorphine and methadone treatment and its relationship with person, treatment, and prescriber characteristics.

Design: Retrospective longitudinal study.

Setting: New South Wales, Australia.

Participants: People entering the opioid agonist treatment program for the first time between August 2001 and December 2015.

Measurements: Time in opioid agonist treatment (primary outcome) was modelled using a generalised estimating equation model to estimate associations with person, treatment, and prescriber characteristics.

Findings: The impact of medication type on opioid agonist treatment retention reduced over time; risk of leaving treatment when on buprenorphine compared with methadone was higher among those that entered treatment earlier (e.g. 2001-2003: OR 1.59, 95% CI 1.44-1.74) and lowest among those that entered most recently (2013-2015: OR 1.24, 95% CI 1.12-1.37). In adjusted analyses, risk of leaving was reduced among people whose prescriber had longer tenure of prescribing (e.g. 3 versus 8 years: OR 0.94, 95% CI 0.93-0.95) compared with prescribers with shorter tenure. Aboriginal and Torres Strait Islander people, being of younger age, past-year psychosis disorder, and having been convicted of more criminal charges in the year prior to treatment entry were associated with increased risk of leaving treatment.

Conclusion: In New South Wales, Australia, retention in buprenorphine treatment for opioid dependence, compared with methadone, has improved over time since its introduction in

2001. Opioid agonist treatment (OAT) retention is affected not only by characteristics of the person and his or her treatment, but also of the prescriber, with those of longer prescribing tenure associated with increased retention of people in OAT.

Keywords: opioid agonist treatment; opiate substitution treatment; methadone; buprenorphine; retention; opioid dependence;

INTRODUCTION

Methadone and buprenorphine are first line medicines for the treatment of opioid dependence[1,2]. Used in this context, they are termed opioid agonist treatment (OAT) and have been classified as essential medicines by the World Health Organization[3]. Both have been shown to be effective in reducing illicit opioid use[4] and multiple adverse events among people with opioid dependence[5] including: transmission of HIV and hepatitis C virus[6,7], contact with the criminal justice system[8,9] and mortality[10]. Long-term use of OAT is recommended[11–13], and retention in OAT is often used as a core outcome in evaluations of treatment effectiveness[14]. However, for multiple reasons, including personal, treatment-related (e.g. medication type or dose) and systemic (e.g. ways in which treatment is provided, barriers to retention related to regulations around OAT provision), some people are not retained in OAT, and cycling in and out of treatment is not uncommon[15–20].

A recent review of studies investigating retention in OAT reported wide variability in potential risk factors depending on the treatment setting, type of OAT, risk factor assessment, outcome definition, sample size and duration of follow-up[21]. Some of the strongest evidence for longer retention relates to person factors including older age[16,22–28], female gender[16,23,29–31], lower levels of criminal activity[16,22,32,33] and lower levels of illicit substance use[23,27,30,34–36]. In terms of treatment-related factors, higher dosages of methadone and buprenorphine have been associated with increased OAT retention[4,26,28,32,34,37–39]. Few studies have investigated how the characteristics of the OAT prescriber may impact a person's retention in treatment.

Investigations of relationships between clinician characteristics and outcomes of people in alcohol and drug treatment report varying effects depending on the type of treatment and population[40]. For example, in a controlled therapeutic community study from the United

States, groups assigned senior staff had improved retention in the first 30-days but not at later periods[41]. In the UK, a randomised trial of psychosocial treatment for alcohol problems found fewer years of therapist experience were associated with positive treatment outcomes[42] while a study of six outpatient treatment programmes found practitioners' clinical work experience was not associated with 90-day retention[43]. Identifying which prescriber characteristics are associated with peoples' retention in OAT could assist services in making informed decisions around how to support the workforce and improve treatment outcomes.

Using a population-based cohort of people who first entered the Australian state of New South Wales (NSW) OAT program between August 2001 and December 2015, this paper summarises retention in buprenorphine and methadone treatment for opioid dependence and examines the association with person, treatment and prescriber characteristics. The specific objectives were to:

1. Examine sociodemographic, treatment and prescriber characteristics of people on first entry to OAT,
2. Summarise retention on OAT, differences in retention between people prescribed buprenorphine and methadone, and changes in the distribution of medications dispensed over time, and
3. Test whether person, treatment and prescriber characteristics are associated with retention in OAT.

METHODS

This retrospective population-based cohort study examined de-identified unit record data from all people commencing an OAT episode for the first time between 1st August 2001 and

31st December 2015, in NSW, Australia, with follow-up data until 31st December 2017. NSW is Australia's most populous state and has the largest OAT programme, providing care for over 40% of all Australian OAT participants[44].

Methadone maintenance programmes were first established in NSW, Australia in the 1970s and were expanded in August 2001 to include buprenorphine. For the period covered by data in this study, approval to prescribe OAT in NSW required medical practitioners to successfully complete a pharmacotherapy accreditation course (PAC), an examination, and a 2–3-hour clinical placement assessment[45]. A different process was required of nurse practitioners wanting to undertake OAT prescribing. Approval was based on having either graduated from an approved master's degree program or providing evidence of their educational development and completing a clinical viva examination, with five thousand hours of advanced practice in the identified specialty needing to be verified and re-authorisation required every five years[45].

At the integration of buprenorphine into the program, practitioners were approved to prescribe buprenorphine if they were already approved to prescribe methadone and had successfully completed additional formal credentialling in buprenorphine. Practitioners not approved to prescribe methadone needed to successfully complete the PAC; they then became approved prescribers of both buprenorphine and methadone[46].

An accredited OAT prescriber is required to initiate a person onto treatment in the NSW OAT program. An initial assessment with the person includes a comprehensive biopsychosocial assessment, discussion of treatment options, and treatment plan development. Once the person is deemed suitable for OAT, prescribers register the person with the Pharmaceutical Regulatory Unit (PRU) of the Ministry of Health and apply for an authority to prescribe them

either methadone or buprenorphine, which is valid for 12 months. Dosing is usually provided through public and private specialist clinics and community pharmacies in a framework that includes medical, social, and psychological treatment[47]. When a person changes medication type, primary dosing point, or exits the program, their prescriber is required to notify the PRU.

Data sources

The current study used five linked state-wide administrative data sources that record information on OAT episodes, criminal convictions, hospitalisations, mental health diagnoses, and mortality. Records were linked probabilistically by the Centre for Health Record Linkage using personal identifiers and subsequently de-identified.

OAT records, obtained from the Electronic Recording and Reporting of Controlled Drugs (ERRCD) database, were available for all treatment episodes since 1985 for people who received at least one episode of methadone and buprenorphine treatment in NSW between August 1st, 2001 and December 31st, 2015 (herein referred to as the study entry period). The cohort for this study included people whose first OAT episode occurred during the study entry period, as defined by the date of first entry recorded in the ERRCD data. The database records dates of admission and exit for all treatment episodes, the type of medication and the setting in which it was dispensed (public, private, Justice Health, and other). Information available on prescribers included date of first authority to prescribe OAT and a business identification number for practices from which they prescribed OAT. Details relating to the other data sources are available in the **Appendix,** and further details of the study design and setting are reported elsewhere[48].

Cases where there was evidence of inconsistent linkage (e.g. inconsistent date of birth; n=85 people), the date of death preceded the treatment start date (n=36 people), or no treatment episode could be matched to a prescriber authority (n=1 person) were removed.

Ethical considerations

Approval for this study was obtained from the New South Wales (NSW) Population & Health Services Research Ethics Committee, the NSW Corrective Services Ethics Committee and the Aboriginal Health and Medical Research Council Ethics Committee.

Definitions

An OAT episode was defined as continuous treatment with no more than a 6-day break[49], and time in OAT calculated as days from treatment episode entry date to episode end date. Treatment was censored at date of death and individuals with no treatment end date were assumed to be in treatment at the end of follow-up (31st December 2017). To adjust for previous medication exposure, total time (in days) spent in methadone and buprenorphine treatment prior to each episode entry was evaluated.

To examine the impact of remoteness on time in OAT, each person's last known postcode of residence was matched with the postcode in the Accessibility/Remoteness Index of Australia Plus 2016 and evaluated as being in a major city or a regional/remote area[50]. Mental health diagnoses (including non-opioid substance use, psychotic, and mood disorder) and self-harm behaviours in the year prior to each episode entry were evaluated (see **Appendix Table 1** for diagnostic code definitions). As peoples' criminographic profiles have previously been shown to impact OAT retention[16,21], a baseline charge history variable was established, defined as

the total number of proven charges committed in the year immediately prior to first entering OAT.

Several prescriber characteristics were evaluated from the available data. On the date each person commenced treatment with authorisation from a prescriber, tenure of OAT prescribing was calculated as the number of years since the prescriber's first ever OAT authorisation. In addition, in the given calendar year, the number of other OAT prescribers in the same practice, and whether a person's prescriber worked in more than one practice, was evaluated.

Cohort groups were defined by calendar year of first OAT entry (2001-2003, 2004-2006, 2007-2009, 2010-2012, and 2013-2015). Age (<25, 25-29, 30-34, and 35+ years) was categorised into four groups by approximate quartile cut-points. Convictions were categorised into zero, 1-3, 4-9, and 10+ categories. Peer group size was grouped to represent prescribers working in single prescriber (zero), small (1-3), medium (4-9) and large (10+) practices.

Statistical analysis

Summary statistics, including counts and percentages, were evaluated for all sociodemographic (sex, age at OAT entry, Aboriginal or Torres Strait Islander status, remoteness), comorbidity, criminographic, prescriber (tenure of OAT prescribing, number of prescribers in practice, prescribing from multiple locations), and treatment (medication type, dosing point, year of first OAT entry, total treatment days prior to episode entry by medication) factors, on first OAT entry.

The number of people entering OAT for the first time were summarised by year and medication type. For first OAT episode, estimates of the survival function for retention were

produced using the Kaplan-Meier estimator. Percentages and descriptive plots of first and all episodes retained over specific time periods are provided by year and medication type. Bar charts were constructed to summarise the distribution of medication types by year among people entering OAT for the first time, as well as among all people engaged in OAT in any given year during the study period.

Univariate and multivariable discrete-time survival analyses were conducted to investigate the impact of person, treatment, and prescriber characteristics on risk of leaving OAT across multiple treatment episodes, using generalised estimating equation models with person-day as the unit of analysis, a binomial distribution and a logistic link function. To account for the clustering within people and prescribers, variance estimates were evaluated using the method described by Miglioretti and Heagerty[51]. To avoid emphasizing small differences resulting from sampling variation (e.g. in later periods and episodes), analyses were based on data from people's first nine OAT episodes and first 150 months in each episode. The outcome was considered censored if a person died or if they were still in treatment at the end of follow-up or at 150 months post episode entry. To capture the shape of the hazard profile across time periods within a single episode and across episodes, all analyses controlled for time since entry (dummies for weeks one to four, months two to twelve, and the logarithm of month for greater than twelve months), episodes (dummies for episodes two to nine), and the interaction of episodes with time (logarithm of month). Once this initial model was specified, the independent characteristics were added to investigate their impact on the hazard. QIC and QICu goodness of fit statistics were used for model comparisons[52]. The effect of covariates on the population logit-hazard profile are captured by the parameter coefficients, which have been exponentiated and reported as odds ratios (OR) with confidence intervals (CI).

No loss to follow-up occurred as this would be indicated by end of a treatment episode. Treatment episodes could be defined by multiple records in the OAT database. Missing treatment and prescriber ID occurred when there was a dosing record but no matching authority record for the period (2.6% of 162,009 OAT records), and 'Unknown' dosing point was recorded in 1.3% of all OAT records. In these cases, there was assumed to be no change in treatment, prescriber or dosing point and information from a recent record was used to complete these records.

The REporting of studies Conducted using Observational Routinely-collected health Data guidelines[53] was followed. Significance tests were done using two-sided tests at a level of 0.05. Analyses were conducted in SAS V9.4 (SAS Institute Inc., Cary, NC, USA) and descriptive plots were produced using R 4.0.0[54] and the *ggplot2* package[55]. The analysis was not pre-registered and results should be considered exploratory.

RESULTS

Cohort summary

A total of 22,577 people commenced OAT for the first time in NSW between 1st August 2001 and 31st December 2015. The majority were male (68.8%), were not Aboriginal or Torres Strait Islander (76.4%), lived in a major city (70.0%) and had no offending history in the year prior to OAT entry (68.5%; see **Table 1**). Annually, the number of new OAT entrants (for years with complete data capture i.e. excluding 2001) was highest in 2002 with 2,206 people and lowest in 2006 with 1,293 people (see **Appendix Figure 1**). The percent of new entrants initiating on methadone reduced over time (74.2% in 2001 to 38.3% in 2015). The median length of follow-up was 9.4 years, ranging from 3 days to 16.4 years, with 1,564 (6.9%) deaths recorded during

the study period. A total of 65,371 episodes were initiated (median, 2; range, 1-37) and 56,411 episodes ended during the follow-up period.

Table 1 about here

Patterns of opioid agonist treatment

First episode

Around nine percent of entrants switched medication type during their first treatment episode. Overall, the median length of time spent in the first treatment episode was 131 days (95% CI: 125-137). Among people initiated on methadone, the median length of time in the first treatment episode was 226 days (95% CI: 212-239) and remained relatively stable during the study period (**Table 2**). For people initiated on buprenorphine, the median first episode length increased over the study period, from 19 days (95% CI: 10-40) in 2001 to 269 days (95% CI: 182-354) in 2015. The change in buprenorphine and methadone retention in people's first episode over time is further illustrated by retention rates at 3, 6, 12 and 24-months, as shown in **Figure 1**. For example, the twelve-month retention rate among new entrants almost tripled over the follow-up period for those initiated on buprenorphine, from 16.6% to 46.0%, compared to only a 2% increase for those initiated on methadone over the same timeframe, from 44.1% to 46.3% (see **Table 2** and **Figure 1**).

Table 2 and Figure 1 about here

Overall treatment engagement

Figure 2 shows the distribution of medication types by year among all people in NSW OAT (i.e. anyone who had entered OAT since it had been made available in NSW (1985); left), as well as limited to those who first entered after integration of buprenorphine into the NSW

program (August 2001; right). Overall, the percent of all people in OAT dispensed only buprenorphine in each year increased over time, from 8.7% in 2002 to 27.1% in 2015; however, among people first entering OAT from August 2001 onwards, the distribution of medication types remained relatively consistent (ranged from 29.8% and 37.8%). Although buprenorphine increased as the index treatment during the study period (from 25.8% in 2001 to 61.7% in 2015; **Table 1**), methadone remained the dominant medication type among people who had first entered OAT before buprenorphine was introduced (>80% on methadone only in every year; see **Appendix Figure 1**).

Figure 3 shows the percent of all OAT episodes retained at select time points, by medication type on entry and year of first OAT entry (see also **Appendix Table 2**). Among all OAT episodes which started with methadone, the percent retained over each time interval was highest among the earliest cohort and reduced among most recent cohorts (e.g., 6-month retention: 68.5% for the 2001-2003 cohort and 63.0% for the 2013-2015 cohort). The opposite was observed for episodes which started with buprenorphine (e.g., 6-month retention: 47.3% in 2001-2003 cohort and 51.1% in the 2013-2015 cohort).

Figure 2 and 3 about here

Factors associated with leaving OAT

Table 3 contains the univariate and multivariable multiple-event discrete survival analysis results modelling time in OAT.

Treatment Factors

In the unadjusted model, being in buprenorphine was associated with an increased risk of leaving treatment compared to being in methadone (OR 1.58, 95% CI 1.46-1.71). Based on

exploratory analysis, differences in OAT retention over time according to OAT medication were explored by testing for cohort group interactions with medication type. Once adjusted for all person, treatment and prescriber variables, the model showed that the effect of medication type on risk of leaving treatment varied by the date of first OAT entry. Odds of leaving treatment when on buprenorphine compared to methadone was higher among people in the earlier OAT cohorts (2001-2003: OR 1.59, 95% CI 1.45-1.75) and reduced over time (2013-2015: OR 1.23, 95% CI 1.11-1.36). The total amount of time using methadone (OR: 0.93, 95% CI 0.92-0.93) or buprenorphine (OR: 0.90, 95% CI 0.89-0.91) in previous episodes was associated with reduced risk of leaving treatment. Receiving dosing in a justice health (i.e. prison) setting (OR: 0.59, 95% CI 0.53-0.66) compared to a public setting was also associated with reduced risk of leaving treatment.

Prescriber Factors

With respect to prescriber variables, people whose prescriber had a longer tenure of OAT prescribing were at a reduced risk of leaving treatment compared to those whose prescribers had less experience. For example, for a prescriber with three years of OAT prescribing tenure, an increase of five years prescribing experience was associated with a 6% reduction in odds (OR: 0.94, 95% CI 0.93-0.95) of the person leaving treatment. In terms of where a prescriber worked, there was no association found between time in OAT and a prescriber's peer group size or whether they were prescribing from multiple locations.

Person Factors

Being an Aboriginal or Torres Strait Islander person (OR: 1.06, 95% CI 1.01-1.11), younger (e.g., <25 years versus 35+ years, OR: 1.13, 95% CI 1.08-1.17), having a past-year psychotic diagnosis at episode entry (OR: 1.11, 95% CI 1.06-1.16), and having four or more offences in

the year prior to first OAT entry compared to none (e.g. 4-9 versus no offences, OR: 1.10, 95% CI 1.06-1.13) were all associated with an increased risk of leaving treatment. A past-year mood disorder (OR: 0.91, 95% CI 0.87-0.94) or non-opioid substance use disorder (OR: 0.95, 95% CI 0.92-0.99) diagnosis in the year prior to episode entry were associated with reduced risk of leaving OAT. Sensitivity analyses were conducted to investigate the impact of using a 28-day break to define a new episode, the results of which are shown in **Appendix Table 3**. Findings were largely consistent between analyses conducted with a 28-day break rule and those presented in this study.

Table 3 about here

DISCUSSION

This study provided a population-based summary of OAT retention in the first episode and across all treatment episodes among new entrants over a 17-year period from the time buprenorphine first became available in the OAT program in an entire Australian jurisdiction. In addition to controlling for characteristics of the person and their treatment, a novel examination of the potential effect of characteristics of prescribers and their work settings on people's time in OAT was undertaken. In addition to reflecting the wide variability of factors impacting OAT retention, these findings also provide several important insights regarding integration of buprenorphine into an existing OAT program.

These results support and extend on those of previous work, showing that buprenorphine compared to methadone was associated with reduced retention among people entering OAT for the first time in the first few years following its introduction into clinical practice as an alternative OAT, but this effect was decreased among more recent cohorts[16]. Possible explanations for the improved retention rate over time may include prescribers early on

viewing buprenorphine as more appropriate for the purpose of detoxification rather than maintenance, or that the induction rates and maintenance doses initially recommended in the buprenorphine clinical guidelines (which were modelled off methadone despite buprenorphine's inherently better safety profile[56–58]) provided suboptimal therapeutic effects. Although information on individual doses was not available in the data, a 2006 revision of the NSW prescriber guidelines for buprenorphine suggests higher starting doses (8mg compared to 4mg) and more rapid dose stabilisation (to be achieved in days rather than 1-2 weeks) compared to the 2001 guidelines[59,60]. It may also be that as clinician knowledge and experience in prescribing buprenorphine increased over time, so too did people's satisfaction with, and retention in, buprenorphine treatment. Considering many countries only offer methadone in their OAT programs[61], it is recommended that settings introducing buprenorphine capitalise off new knowledge and experience with using buprenorphine in other settings and ensure it is delivered in conjunction with continued training and support for OAT prescribers[62,63]. Further, the finding that people engaged in OAT in Justice Health settings were associated with improved retention highlights the opportunity that expanding OAT availability in prison could provide both for improving retention and reducing related harms in jurisdictions where OAT in prison remains limited or unavailable[5].

After controlling for person and treatment-related characteristics, a prescribers' tenure of OAT prescribing was associated with increased retention of people in OAT. Although previous studies have shown mixed findings with regards to clinician tenure and person retention in other alcohol and other drug treatment services[40], the observed effect is likely to reflect a greater level of knowledge, confidence, and experience on the part of the OAT prescriber[63,64]. Evidence that more experienced OAT prescribers are less concerned with induction logistics, expert consultation, and clinical dosing guidelines suggests this may also indicate an increased

capability of recognising and responding to people's clinical needs through individualised prescribing[63,64]. Recent findings that a high concentration of people in NSW OAT are cared for by a small number of OAT prescribers and newer OAT prescribers are ceasing prescribing highlights potential challenges for the system in supporting the future needs of the growing treatment population[45]. Greater prescriber education, mentorship programs, and program quality monitoring are possible strategies to address these aspects and improve retention of OAT for people prescribed buprenorphine and methadone.

Although the current study identified the effect of several person, treatment and prescriber characteristics on time in OAT, it is important to recognise systemic factors that undermine people's continued engagement with treatment. For example, it is if often the case in this programme that people are required to attend a dosing point multiple times per week[59], which can impede efforts to find and maintain employment as well as negatively affect personal relationships. Depot buprenorphine is a novel approach to delivering treatment that could improve retention through requiring less frequent attendance at dosing points[65]; consideration of providing more take-home doses is also an option that would improve treatment flexibility and potentially retention. The financial burden caused by OAT can also negatively impact retention[66]. Although OAT medications are subsidised in some settings, most people dispensed OAT outside of public and Justice Health settings are required to pay a dispensing fee (typically $A5–$A8 per day) that is higher than the cost of accessing other prescription medicines on Australia's Pharmaceutical Benefits Scheme[59,67]. This has resulted in people with limited financial resources incurring debt to pharmacies, having to prioritise medication over other essentials, or terminating treatment entirely. Such inequity is unlikely to change without government sponsorship[68,69]. These issues highlight the need to address barriers to treatment retention at each of the person, prescriber, and system levels.

Study strengths and limitations

This study has a number of strengths, including the use of linked administrative datasets to examine over 16 years of concurrent buprenorphine and methadone prescribing among the entire population of people initiating OAT in NSW – allowing considerable evaluation of differences in retention, as well as changes over time as buprenorphine became more established in the program. As a result, the findings are representative of people who are in OAT in NSW but may not be representative of individuals who receive OAT in other jurisdictions. Treatment engagement was considered through modelling retention over subsequent treatment episodes and the time-varying nature of treatment and prescriber factors were captured. This is also one of the first studies to consider prescriber characteristics as factors influencing people's OAT retention modelled in a continuous time-to-event framework with long-term follow-up[40].

As this was an observational study, there was no random assignment to medication type. Some of the observed differences in retention by medication type may therefore be confounded by differences in the characteristics of people beginning treatment with one medication or the other. As analysis was based on linked administrative data, information was restricted to that which was routinely collected. Although several important confounders were adjusted for, information on severity of opioid dependence, doses prescribed, treatment quality, prescriber training, adjunct service use (e.g. counselling) and person-level factors motivating retention or level of engagement with OAT were unavailable and warrant further consideration. Inconsistencies may have arisen from using probabilistic linkage. However, the OAT dataset is considered to be of high accuracy given proof of identity must be shown before a prescription can be issued. In addition, the linkage process, which involves

the application of probabilistic techniques combined with quality assurance checks, was developed to achieve high linkage rates while minimising errors[70].

Conclusion

Retention rates for people receiving buprenorphine have continued to increase over time. Examining explanations for the improvement in buprenorphine retention could help support its availability as a treatment option for other jurisdictions and inform the processes needed to optimise retention in the first few years following integration. Characteristics of the prescriber, as well as those related to the person and their treatment, were associated with retention in OAT. Greater education and mentorship programs to support prescribers of OAT are possible strategies to improve retention of OAT for people prescribed buprenorphine and methadone.

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Declarations of interest

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Table 1. Counts (N) and percentages (%) of person and prescriber characteristics for people who entered opioid agonist treatment (OAT) for the first time in New South Wales between 2001-2015

Characteristic	Level	N	%
Person variables			
Gender	Female	7,042	31.2%
	Male	15,535	68.8%
Age at treatment initiation	<25 years	6,147	27.2%
	25-29 years	5,298	23.5%
	30-34 years	4,150	18.4%
	35+ years	6,982	30.9%
Aboriginal and/or Torres Strait Islander		5,329	23.6%
Remoteness disadvantage	Major Cities	15,793	70.0%
	Regional/Remote	6,629	29.4%
	Unknown	155	0.7%
Number of offences in year before entry	0 (none)	15,475	68.5%
	1-3	3,984	17.7%
	4-9	2,346	10.4%
	10+	772	3.4%
Comorbidities in year before entry	Self-harm	763	3.4%
	Psychotic disorder	1,048	4.6%
	Substance use disorder (excl. OUD)	3,570	15.8%
	Mood disorder	2,466	10.9%
Prescriber variables[a]			
Length of prescriber experience	0-<4 years	5,301	23.5%
	4-<8 years	4,263	18.9%
	8-<14 years	6,860	30.4%
	14+ years	6,153	27.3%
Number of prescribers in practice	0 (none)	13,184	58.4%
	1-3	4,523	20.0%
	4-9	3,595	15.9%
	10+	1,275	5.7%
Works in multiple locations	No	8,876	39.3%
	Yes	13,701	60.7%

OUD, opioid use disorder; [a] Evaluated on the date the person commenced treatment with authorisation from the prescriber;

Table 2. Retention characteristics of the first episode for people entering opioid agonist treatment (OAT) for the first time by year of OAT entry, including the percent (%) of first episodes retained for 3, 6, 12, and 24 months and median episode length of first episode

	Year of first OAT entry					
	2001	**2003**	**2006**	**2009**	**2012**	**2015**
Overall						
First-time entrants (N)	724	1,961	1,293	1,570	1,406	1,351
Treatment retention in first episode[a] at… (%)						
3 months	54.4%	47.8%	52.1%	58.2%	55.5%	63.4%
6 months	47.0%	37.0%	42.8%	48.6%	46.6%	54.8%
12 months	37.0%	25.1%	31.9%	37.6%	37.9%	46.1%
24 months	25.8%	17.4%	22.4%	27.3%	28.0%	37.3%
Median days in first episode (LCL, UCL) [b]	142 (98, 192)	77 (64, 90)	109 (86, 130)	166 (136, 193)	143 (119, 175)	273 (223, 329)
Buprenorphine on entry	25.8%	53.6%	42.2%	48.0%	60.1%	61.7%
Buprenorphine on entry						
First-time entrants (N)	187	1,052	545	754	845	833
Treatment retention in first episode[a] at… (%)						
3 months	35.3%	34.0%	40.6%	48.8%	53.1%	62.2%
6 months	27.3%	24.9%	32.7%	39.7%	42.4%	53.7%
12 months	16.6%	16.4%	24.4%	31.6%	34.0%	46.0%
24 months	12.3%	11.4%	16.9%	22.5%	24.5%	36.5%
Median days in first episode (LCL, UCL)[b]	19 (10, 40)	31 (26, 38)	49 (35, 63)	85 (63, 103)	120 (87, 144)	269 (182, 354)
Methadone on entry						
First-time entrants (N)	537	909	748	816	561	518
Treatment retention in first episode[a] at… (%)						
3 months	61.1%	63.7%	60.6%	66.9%	59.0%	65.4%
6 months	53.8%	50.9%	50.1%	56.9%	52.9%	56.8%
12 months	44.1%	35.2%	37.4%	43.3%	43.9%	46.3%
24 months	30.5%	24.3%	26.3%	31.6%	33.3%	38.6%
Median days in first episode (LCL, UCL) [b]	236 (169, 305)	195 (161, 231)	182 (142, 226)	257 (215, 305)	234 (162, 313)	282 (224, 384)

N, number; LCL and UCL are lower and upper 95% confidence limits, respectively; Note, 2001 summaries based on partial-year data capture (from August to December).

[a] Percent of people who did not actively cease their first treatment episode during the specified time interval; people who died during the interval were classified as retained.

[b] Estimates of median episode length, from time of first episode entry to cessation (or censored at death or end of follow-up) produced from the Kaplan-Meier estimator.

Figure 1. First episode retention rates for 3, 6, 12, and 24 months by treatment type and year of entry

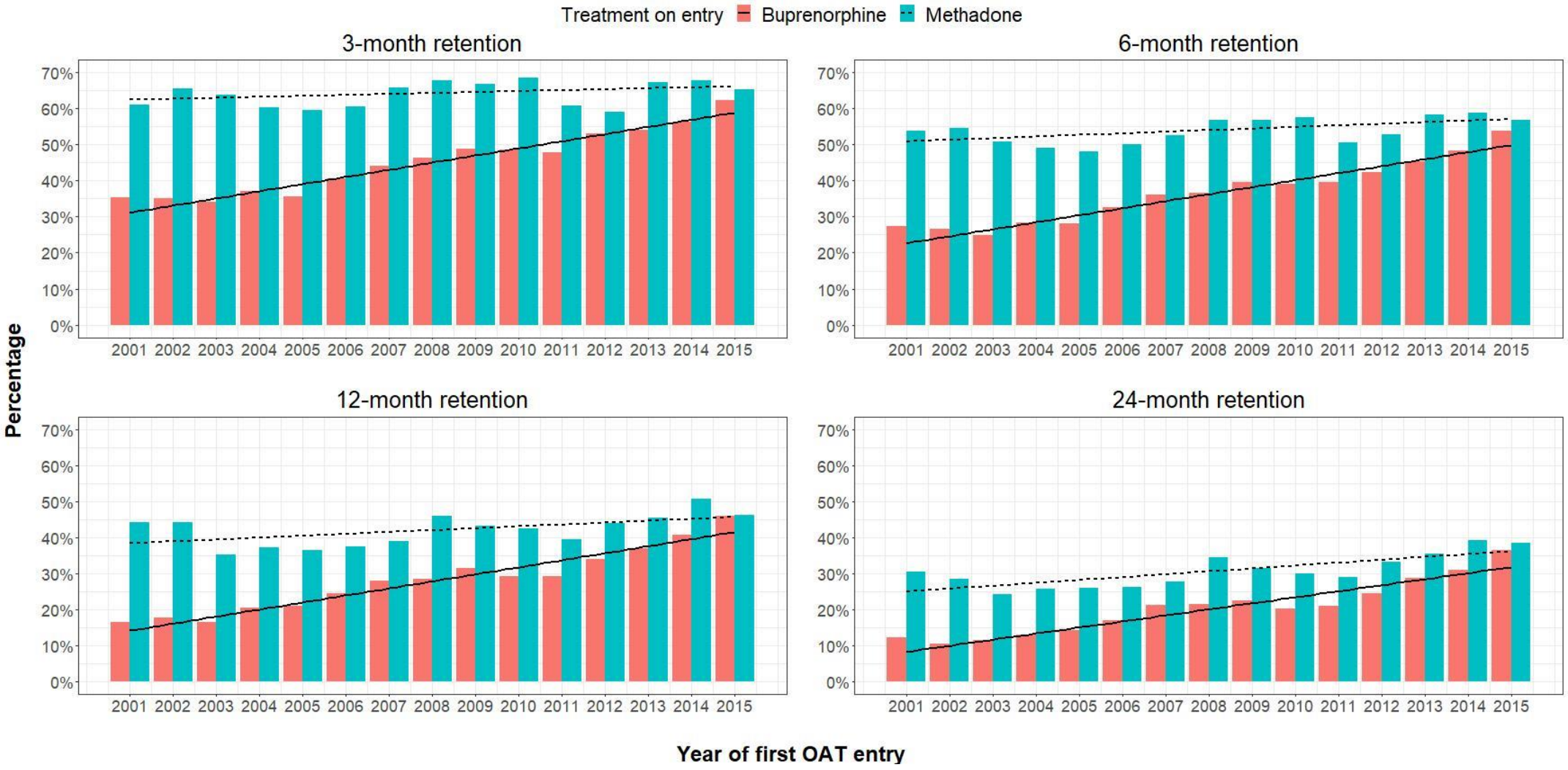
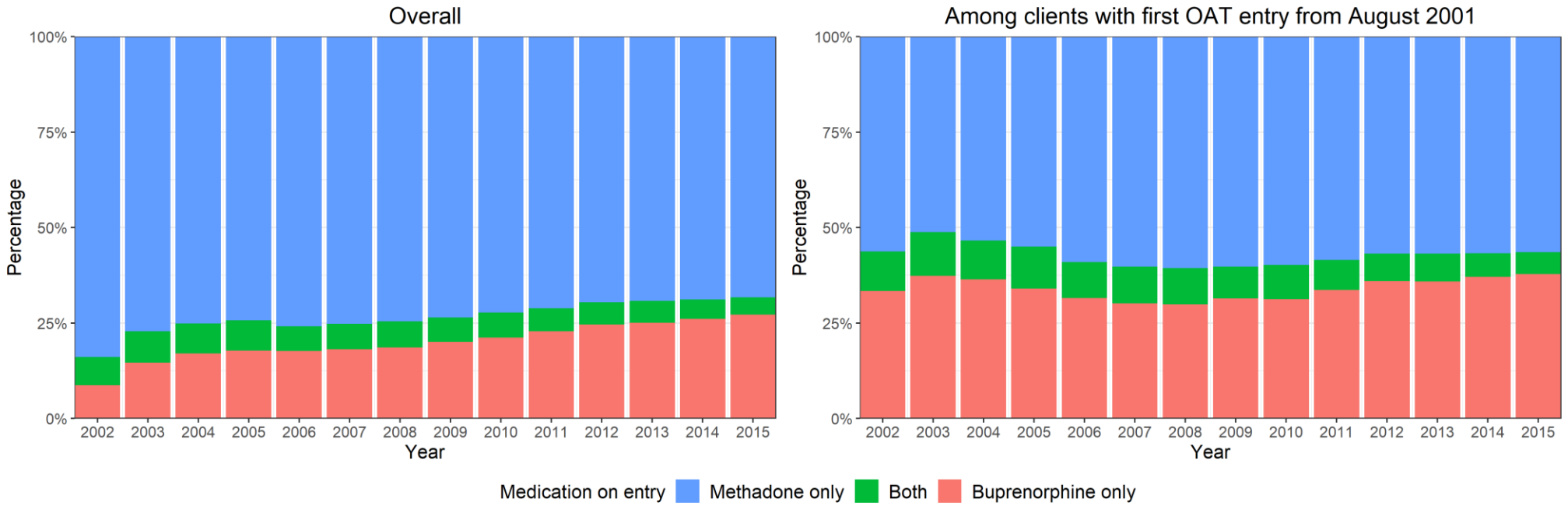
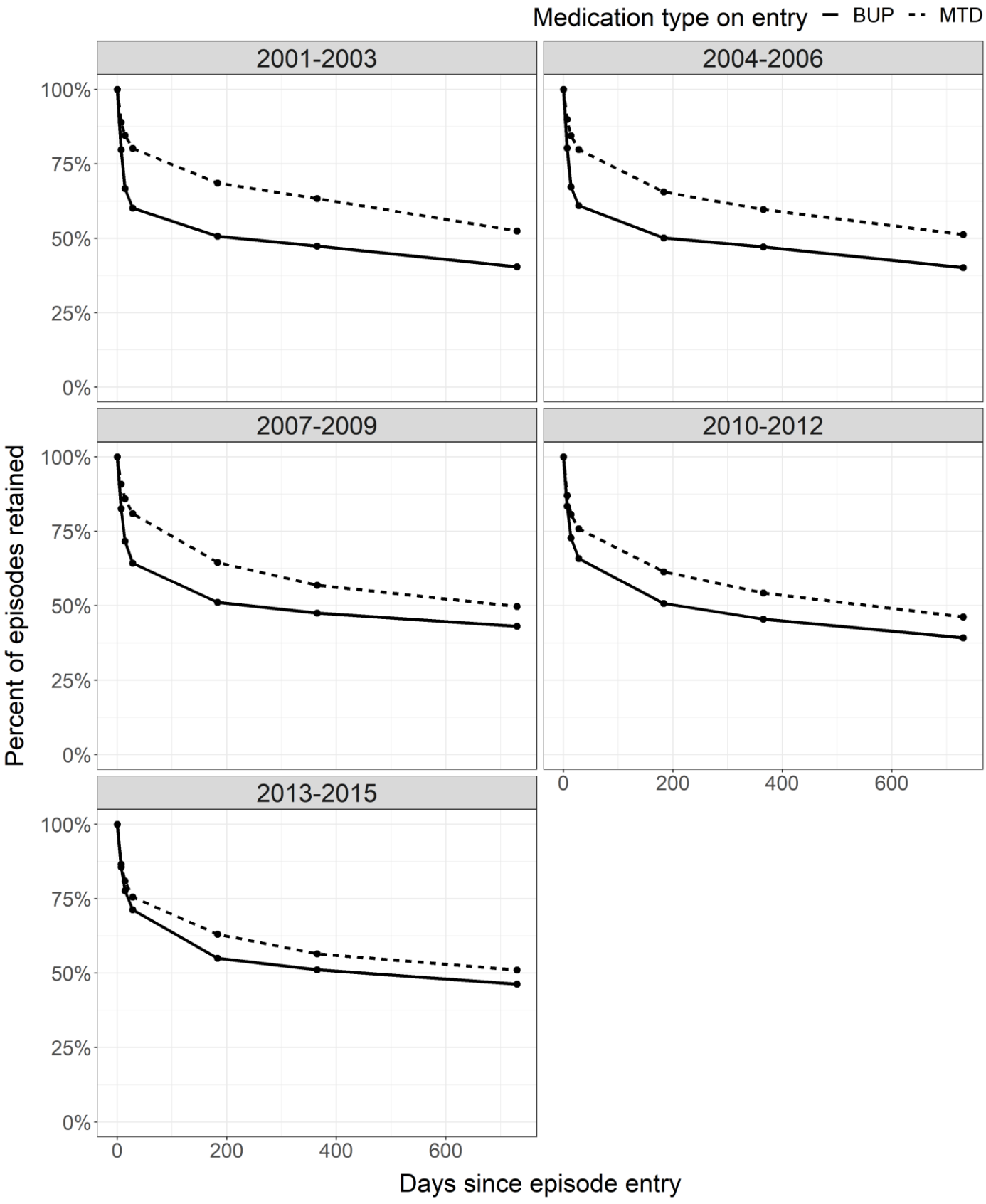


Figure 2. Distribution of medication types by calendar year among all people in the OAT program who received treatment between 2001-2015 (i.e. all people who had entered OAT since it had been made available in NSW (1985); left), and limited to those with a first OAT entry after 2001 and the availability of buprenorphine into OAT (right)



Both plots show, among people with at least one day of opioid agonist treatment within each calendar year, the percent who received methadone, buprenorphine, or who received both in the same year (non-concurrently).

Figure 3. Percent of all OAT episodes retained at selected time points (7, 14, 28, 123, 365, and 730 days), according to medication type at episode entry and year of people's first OAT entry[1]



[1] Calculated as the percent of episodes with continuous treatment for equal to or longer than the specified time, conditioning on the person still being in follow-up and not having entered a new treatment episode within that time interval.

Table 3. Unadjusted and adjusted generalised linear model results for leaving treatment in all OAT episodes

		Unadjusted		Adjusted	
Variable	**Level**	**OR**	**95% CI**	**OR**	**95% CI**
Treatment variables					
Buprenorphine (Ref: Methadone)[a]		1.58*	(1.46, 1.71)		
Year of first OAT entry	2001-2003 (Ref.)	1			
	2004-2006	0.88*	(0.85, 0.91)		
	2007-2009	0.82*	(0.79, 0.85)		
	2010-2012	0.81*	(0.77, 0.86)		
	2013-2015	0.67*	(0.62, 0.73)		
Buprenorphine (Ref: Methadone)[a] by year of first OAT entry	2001-2003			1.59*	(1.45, 1.75)
	2004-2006			1.67*	(1.53, 1.83)
	2007-2009			1.57*	(1.42, 1.73)
	2010-2012			1.46*	(1.33, 1.60)
	2013-2015			1.23*	(1.11, 1.36)
Cumulative days spent in treatment prior to current episode (medication-specific; 1-day offset and log-transformed)	Methadone	0.91*	(0.90, 0.92)	0.93*	(0.92, 0.93)
	Buprenorphine	0.93*	(0.92, 0.94)	0.90*	(0.89, 0.91)
Dosing point[a]	Public (Ref.)	1		1	
	Private	0.97	(0.86, 1.08)	1.00	(0.92, 1.08)
	Justice Health	0.54*	(0.48, 0.60)	0.59*	(0.53, 0.66)
	Other	1.11	(0.99, 1.24)	0.97	(0.87, 1.07)
Person variables					
Male		0.93*	(0.89, 0.96)	0.98	(0.95, 1.00)
Age at treatment initiation	<25 years	1.11*	(1.05, 1.17)	1.13*	(1.08, 1.17)
	25-29 years	1.04*	(1.00, 1.09)	1.06*	(1.02, 1.10)
	30-34 years	1.00	(0.96, 1.04)	1.02	(0.98, 1.05)
	35+ years (Ref.)	1		1	
Aboriginal and/or Torres Strait Islander (Ref: No)		0.92*	(0.86, 0.98)	1.06*	(1.01, 1.11)
Major city (Ref: Regional/Remote)		1.11*	(1.03, 1.18)	0.99	(0.92, 1.05)
Number of convicted offences in year before first OAT entry	0 (Ref.)	1		1	
	1-3	0.95*	(0.92, 0.98)	1.02	(0.99, 1.05)
	4-9	0.94*	(0.90, 0.98)	1.10*	(1.06, 1.13)
	10+	0.90*	(0.85, 0.96)	1.11*	(1.05, 1.18)
Comorbidities in year prior to episode entry	Self-harm	0.96	(0.90, 1.02)	1.03	(0.97, 1.09)
	Psychotic disorder	0.96	(0.91, 1.02)	1.11*	(1.06, 1.16)

	Substance use disorder (excl. OUD)	0.93*	(0.89, 0.97)	0.95*	(0.92, 0.99)
	Mood disorder	0.87*	(0.83, 0.90)	0.91*	(0.87, 0.94)
Prescriber variables[b]					
Tenure of OAT prescribing (log-transformed)					
For a 5-year increase from…	0 years	0.80*	(0.72, 0.89)	0.88*	(0.86, 0.90)
	3 years	0.90*	(0.86, 0.95)	0.94*	(0.93, 0.95)
	6 years	0.93*	(0.91, 0.97)	0.96*	(0.95, 0.97)
	9 years	0.95*	(0.93, 0.97)	0.97*	(0.97, 0.98)
Number of other OAT prescribers in practice	0 (Ref.)	1		1	
	1-3	1.10	(0.94, 1.28)	1.06	(0.94, 1.20)
	4-9	1.04	(0.94, 1.16)	1.03	(0.94, 1.14)
	10+	0.86*	(0.76, 0.96)	1.12	(0.92, 1.35)
Works in multiple locations		0.88*	(0.80, 0.96)	1.01	(0.93, 1.09)

OR, odds ratio; CI, confidence interval; Ref, reference level; OUD, opioid use disorder. * Significant at the 0.05 level, two-sided test.

All generalised estimating equation analyses are based on data from people's first nine OAT episodes and first 150 months in each episode with person-day as the unit of analysis, a binomial distribution, a logistic link function and a compound symmetry working correlation for repeated observations within people. To capture the shape of the hazard profile across time periods within a single episode and across episodes, all analyses controlled for time (dummies for weeks one to four, months two to twelve, and the logarithm of month for greater than twelve months), episodes (dummies for episodes two to nine), and the interaction of episodes with time (logarithm of month). The event modelled was end of an OAT episode, so an OR greater than one indicates an increased risk of leaving OAT.

Thirty-three people were excluded due to having no known dosing point and 155 people were excluded due to unknown remoteness classification. Therefore, data include 61,472 episodes and 52,940 treatment cessations.

[a] Modelled as time-dependent variables.

[b] Evaluated on the date the person commenced treatment with a new authorisation from the prescriber.