A Data Linkage Evaluation of the Outcomes of the NSW Involuntary Drug and Alcohol Treatment (IDAT) Program

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SUMMARY OF FINDINGS

This study used administrative data to evaluate the effectiveness of the IDAT program on three important health-related outcomes: mortality, emergency department presentations, and unplanned hospital admissions in the year following IDAT.

IDAT patients (n=277) were compared to a control group (n=277), taking a one-year period before IDAT or treatment as usual (the index treatments) and a one-year period after IDAT or treatment as usual. The proportion, number, and cost for hospital admissions and ED presentations were compared before and after the respective index treatments.

The control group was generated by selecting a sample of people who were matched to IDAT patients on key characteristics. The control group:

- Were dependent on alcohol or methamphetamines
- Had received alcohol or other drug treatment in the year before index treatment
- Had the same average number of hospital admissions in the year before index treatment (ie frequent attenders)
- Had the same average number of ED presentations in the year before index treatment (ie frequent attenders)
- Received AOD treatment (treatment as usual) instead of IDAT

The comparisons between the IDAT and control groups controlled for age, gender, number of alcohol or drug treatment episodes received, principal drug of concern, and homelessness.

For the emergency department outcomes (measured in several ways) and unplanned hospital admissions (also measured in several ways), the IDAT program was associated with significant decreases in utilisation of these health services. This is an indication of positive IDAT outcomes and parallels the pre-post outcome study findings (using patient-interview data).

However, when we compared the IDAT outcomes to the matched control group, the outcomes for IDAT patients over a 12-month period post treatment were not statistically significantly different from the matched controls. We hypothesised that the IDAT group, having received the intensive IDAT treatment program, would have improved health status (as reflected in lower ED presentations and unplanned hospital admissions) compared to the control group who received treatment as usual. This did not appear to be the case.

In relation to mortality, there was a high mortality rate in IDAT patients 12 months after IDAT treatment. Twenty people had died in the 12 months after leaving IDAT, a rate of 7,220 per 100,000 person-years (py). In the control group, the number of deaths was 14, and the rate 5,054 per 100,000 py. The difference in the mortality rate was not statistically significantly different.

While treatment under the IDAT program was associated with reduced health service utilisation in the year following the IDAT treatment, it did not differ from those of a suitably matched control group. This suggests that, on these measures, there is no net advantage for IDAT as an intervention relative to treatment as usual.

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

INTRODUCTION

Background

Involuntary treatment is one of the current treatment approaches for individuals with severe alcohol and drug dependence in Australia. It aims to provide involuntary care outside the criminal justice system to individuals with severe alcohol and drug dependence who are at risk of harm to themselves or others. Internationally, involuntary treatment exists in different forms and is known by a number of different labels, including: *civil commitment, quasi-compulsory treatment* and *compulsory detention*. The arrangements under law and in operational practice vary across the globe with more than 80% of countries having legislation for involuntary treatment [1].

Involuntary treatment can be controversial, impacting as it does on conceptions and experiences of individual rights and state responsibilities [2]. Although involuntary treatment for alcohol and drug dependence has occurred for centuries, methodologically sound studies of effectiveness, particularly for people who do not engage in illegal behaviours, are limited [3]. This uncertainty fuels arguments that depriving an individual of his/her liberty cannot be ethically justified if the intervention is not known to be of benefit.

Within Australia, jurisdictions have different legislative frameworks regarding involuntary treatment. In New South Wales (NSW) involuntary treatment had previously been provided under the Inebriates Act 1912. However, a review of that Act, recommended at the 2003 Summit on Alcohol Abuse and subsequently conducted in 2004 by the Parliament of New South Wales Standing Committee on Social Issues, concluded that the Inebriates Act is "fundamentally flawed" and recommended that it be "immediately repealed" [4]. As a result of this review, the *Drug and Alcohol Treatment Act* 2007 replaced the *Inebriates Act* 1912 and provides the legislative basis for the involuntary detention, treatment and stabilisation for persons with severe substance dependence, with the stated aim of protecting the health and safety of such persons, while also aiming to address all human rights aspects that were the subject of criticism of the previous legislation. Under the new legislation, the Involuntary Drug and Alcohol Treatment Program (the IDAT program) was developed to "provide short term care, with an involuntary supervised withdrawal component, to protect the health and safety of people with severe substance dependence who have experienced, or are at risk of, serious harm and whose decision-making capacity is considered to be compromised due to their substance use" [4].

Evaluation determining the feasibility, appropriateness, effectiveness and the costs of the IDAT program is critical to assist NSW policy makers in their decision making about the IDAT program. In April 2016, the NSW Ministry of Health competitively selected an evaluation team, the Drug Policy Modelling Program, then at the National Drug and Alcohol Research Centre, UNSW Sydney to conduct an evaluation of the IDAT Program. The evaluation was conducted between April 2016 and February 2020.

The IDAT Program Evaluation had four components: 1) a process evaluation (completed in April 2017); 2) a cost assessment (completed in March 2018); 3) an outcome evaluation using patient-interview data (completed in July 2019); and 4) and an outcome evaluation using linked data (the subject of this current report).

The data linkage study

The IDAT Data Linkage Study provided the opportunity to compare IDAT patients to a comparison group comprised of people in similar circumstances to those of IDAT. It used administrative health and mortality records, rather than directly collected patient data. The key comparisons were conducted on changes in health service usage (12 months before and 12 months after IDAT, in comparison with a control group), including changes in emergency admissions, unplanned hospital admissions and differences in mortality between the two groups.

The *primary aims* of the "IDAT Data Linkage Study" were to:

1. determine if IDAT patients have a significant reduction (12 months after treatment compared to 12 months before treatment) in emergency department admissions, unplanned hospital admissions, and the costs associated with these in comparison to a suitably matched control group.
2. determine if, in comparison to a suitably matched control group, those in IDAT have on average a lower mortality rate in the 12 months after IDAT treatment;

Research questions

The following specific research questions were answered via the data analyses in this evaluation:

Mortality

1. What is the mortality rate in the 12 months after IDAT commencement? Is this significantly different from the mortality rate for those in a matched control group who did not receive IDAT?

Emergency department visits

2. Is there a significant difference in the *proportion of people who had at least one ED visit* in the 12 months after treatment, between IDAT and a matched control group?
3. Is there a significant difference in the *number of ED visits* in the 12 months after index treatment, between IDAT and a matched control group?
4. Is there a significant difference in the *cumulative ED cost (cost of all ED visits combined)* in the 12 months after index treatment, between IDAT and a matched control group?

Unplanned hospital admissions

5. Is there a significant difference in the *proportion of people who had at least one unplanned hospital admission* in the 12 months after index treatment, between IDAT and a matched control group?
6. Is there a significant difference in the *number of unplanned hospital admissions* in the 12 months after index treatment, between IDAT and a matched control group?
7. Is there a significant difference in the *cumulative unplanned hospital admission length of stay (LOS)* in the 12 months after index treatment, between IDAT and a matched control group?
8. Is there a significant difference in the *cumulative unplanned hospital cost (cost of all hospital admissions combined)* in the 12 months after index treatment, between IDAT and a matched control group?

METHOD

Study design

The "IDAT Data Linkage Study" was a retrospective cohort design using routinely collected administrative health data for IDAT patients and a matched control group. All data were anonymised before being presented to the research team.

The timeframe for the data collection for the data linkage component was 7 years, from 1 May 2011 to 30 April 2018, in which each study participant had a 24-month window of data collection (12 months pre and 12 months post commencement of index treatment: IDAT treatment for the IDAT patient and "treatment as usual" for the control group).

For this study, **index treatment** was defined as:

1. For IDAT patients: IDAT patients were identified via IDAT treatment codes[1]. Each IDAT patient might receive multiple treatment episodes. The first treatment episode is the "index" treatment for IDAT patients.
2. For the control patients: Control patients were identified via the NSW Minimum Data Set for Drug and Alcohol Treatment Services (NSW MDS DATS) as receiving at least one treatment as usual (TAU) treatment episode (see inclusion criterion no.2 in the section below for definition of TAU). The first TAU episode is the "index" treatment for the control patients.

Detailed description of the 5 data collections

Five data collections were used for this data linkage study, as described in Table 1.

Table 1: Data collections descriptions and outcome measures

Dataset and data custodian	List of key variables (from data dictionaries)	Outcome measures / ways in which data used
1. NSW Admitted Patient Data Collection (APDC)	This dataset covers all inpatient episodes from public, private and repatriation hospitals, private day procedures centres and public nursing homes in NSW. The APDC holds data on the dates of admission and separation, up to 50 diagnoses and procedures (ICD-10-AM), Australian Refined Diagnostic Related Groups (AR-DRGs), source of referral and separation mode (discharge, transfer or death). The key variables are start date and end date of hospital admission (including mental health), ICD code, DRG item code according to current AR-DRG Public Sector Estimated Cost Weights as average cost (for costing work comparing hospital cost across two	This data collection was used to count unplanned hospital admissions in the 12 months pre and 12 months post index treatment, and used to match controls to IDAT. Unplanned hospital admissions 12 months pre and 12 months post index treatment: 1. Proportion (of people with at least one admission Yes/No)

[1] Within the NSW MDS DATS, the IDAT program has a separate code of *"70 – Involuntary D&A Treatment (IDAT)"* under the variable "Main Service Provided". Because the code 70 was not introduced in the NSW MDS DATS until late 2014, the code of 20 and 21 (old codes) under the variable "Main Service Provided" were also used to identify IDAT patients. In addition, the codes of 11E535 and 11N537 (for the variable "Establishment_identifier", one for Royal North Shore Hospital and the other for Bloomfield Hospital, the two IDAT Treatment Units) were also used to identify records belonging to IDAT patients.

Dataset and data custodian	List of key variables (from data dictionaries)	Outcome measures / ways in which data used
	groups).	2. Cumulative length of stay (LOS) 3. Frequency (number of admissions) 4. Cumulative cost
2. NSW Emergency Department Data Collection (EDDC)	This dataset records all emergency department visits to 90 public emergency departments across NSW. There are 150 emergency departments in NSW. Most of the larger departments contribute data to the EDDC so the dataset includes the majority of ED attendances. Using the APDC, it is possible to identify ED presentations which resulted in an admission to hospital. The key variables are start date and end date, cause of emergency services, triage category according to current National Hospital Cost Data Collection Round 17 as average cost per presentation (for costing work comparing ED cost across two groups).	This data collection was used to count ED presentations in the 12 months pre and 12 months post index treatment, and used to match controls to IDAT. ED visits 12 months pre and 12 months post index treatment: 1. Proportion (of people with at least one ED visit Yes/No) 2. Frequency (number of ED visits) 3. Cumulative cost
3. NSW Drug and Alcohol Minimum Data Set (NSW MDS DATS)	The NSW MDS DATS data collection collects information across NSW about the patients and activities of AOD services. It consists of 44 separate items to be collected throughout the course of the service episode. Data is reported monthly, with annual reporting being on a financial year basis. Agencies covered by the data collection are required to submit a complete data set for each service episode that was either open or completed during the reporting month. The key variables will be type of main AOD services provided and other AOD services provided, start date and end date of each AOD treatment.	This data collection was used as source data to: 1) identify the IDAT group and the control group for this study; 2) to identity the "service_start_date" and "service_end_date" of the first index treatment episode in order to identity the time span for 12 months pre index treatment and 12 months post index treatment; and 3) to create a covariate variable named "treatment_episodes" which indicates the number of AOD treatment episodes during the 12 months post treatment index. This covariate is used in all the final analyses. See Appendix 1 for method to calculate the covariate variable "treatment_episodes"
4. NSW Mental Health Ambulatory Data Collection (MHADC)	MHADC collects non-admitted mental health services across NSW. It includes mental health day programs, psychiatric outpatients and outreach services (eg, home visits). Also included is care provided by hospital-based consultation-liaison services to admitted patients in non-psychiatric and hospital	This data collection was used as source data to create the "complexity score" to be used to check the matching process for the two groups (see

Dataset and data custodian	List of key variables (from data dictionaries)	Outcome measures / ways in which data used
	emergency settings; care provided by community workers to admitted patients and patients in staffed community residential settings and mental health promotion and prevention services. The key variables are mental health diagnosis code, activity code mental health, start date and end date of mental health services, frequency of contact, and types of activity.	Appendix 2 on method to calculate the variable "complexity score". The mental health variable "diagnosis code" was used within the "complexity score").
5. NSW Mortality Data	For deaths registered from 2007 onwards, the Centre for Epidemiology and Evidence, NSW Ministry of Health receives coded cause of death data from the Australian Coordinating Registry (ACR) for the Cause of Death Unit Record File (COD URF). The key variable are date of death; COD URFs are available much later than the death registration data (up to 12 months) due to the time needed for coding and cleaning of the data. As such, it is not possible to have COD URFs for this evaluation.	This data collection was used to identify people who died in both the IDAT and the control groups. The outcome variable is mortality rate, which was compared between the two groups using survival analysis method.

Study population

The "IDAT Data Linkage Study" involved two participant groups: 1) IDAT patients; 2) a control group.

The IDAT patients: IDAT patients who had received treatment in the IDAT program at any time from its commencement (May 2012) and had patient records within the NSW Ministry data linkage system were able to be included. The IDAT patients were identified in the NSW Drug and Alcohol Minimum Data Set (NSW MDS DATS) by the data linkage organisation (CHeReL).

The IDAT data provided by the CHeReL to the research team had 690 records for 277 unique patients. Using the appropriate treatment codes (see 1 above) to filter the data, the final number of records for the IDAT group was 478 records, representing 277 unique patients.

The control group: The intention with the control group was to identify patients who would meet program inclusion criteria for IDAT but who did not receive such services. The IDAT program targets people who have severe alcohol or other drug dependencies, and who have been unsuccessfully treated previously, and who are frequent attenders for care. Therefore, the control cohort were those who had an alcohol or meth/amphetamine dependence, were frequent attenders at hospitals and/or emergency departments in the period of 12 months prior to index treatment, and had received some form of AOD treatment at least once, but not received IDAT.

Below are the ***inclusion criteria*** for the control group:

1. Have not received treatment in the IDAT program in the period of 1 May 2012 to 30 April 2018;
2. Have received "treatment as usual" drug and alcohol treatment services at least once in the period of 1 May 2011 to 30 April 2017 (identified via the NSW MDS DATS)[2];

[2] "Treatment as usual" is defined as records that have "Main Services Provided" codes of 21, 22, 31, 32 (old codes) and 20, 30, 48 (new codes) for withdrawal management/detox, rehabilitation activities, and maintenance pharmacotherapy non-opioid, respectively.

3. Be identified via the Emergency Department Data Collection (EDDC) or the Admitted Patients Data Collection (APDC) as having had an ICD-10-AM codeset F10.X for medical conditions as the result of the harmful use of alcohol or an ICD-10-AM codeset F15.X for medical conditions as the result of the harmful use of stimulants (meth/amphetamine) (or the equivalent SNOMED codes) in the period of 1 May 2011 to 30 April 2018. See appendices 3 and 4 for the full list of ICD codes for the APDC and the ICD codes and SNOMED codes for the EDDC. The reason for only including alcohol and meth/amphetamine was because they are the most common drugs of concern for IDAT patients (83% alcohol and 9% meth/amphetamine according to IDAT database analysis as part of the IDAT Process Outcome Evaluation);

(See detailed specific steps to identify the pool for the control group in Appendix 5).

This provided a potential pool of n=8935 from which to draw a suitable control group.

There are a number of ways in which a suitable matched control group can be selected from the large potential pool of control participants with the above characteristics. The control group could be matched on demographic and clinical characteristics (such as age, gender, principal drug of concern), and/or matched on whether they would have been likely recipients of IDAT, that is matched on the number of hospital admissions and emergency department admissions in the year preceding treatment[3].

Using propensity score ("nearest neighbour matching method") as the matching tool, and matching on a ratio of 1:1, that is creating a control group comprised of 277 controls, we explored all of these options (see Appendix 6). Propensity score matching is a statistical technique that has proven useful to evaluate treatment effects when using quasi-experimental or observational data. Propensity scores are defined as the conditional probability of assigning a unit to a particular treatment condition (i.e., likelihood of receiving treatment), given a covariate or a set of observed covariates. The propensity score then allows matching of individuals in the control and treatment conditions with the same likelihood of receiving treatment. When the creation of the n=277 control group included best available matches on demographics, principal drug of concern and hospital and ED admissions (all combined), the result produced minor differences on the two key pre-treatment variables of interest (number of hospital admissions and number of ED presentations). When the creation of the control group was driven only by the pre-treatment variables of interest (hospital admissions and ED presentations) there were identical median (and mean) numbers of pre-treatment ED presentations and hospital admissions between the two groups.

Given that the study aimed to examine the outcomes for IDAT recipients compared to those who would meet eligibility criteria for IDAT (frequent attenders at hospitals, past AOD treatment), the closer matched control group using only two variables for matching was the preferred approach. In summary, the control group was created from matching on: 1) the number of ED visits 12 months prior to index treatment; and 2) the number of unplanned hospital admissions 12 months prior to index treatment. Recalling that all the potential group met criteria for alcohol or meth/amphetamine dependence and past AOD treatment history.

To test whether the selected controls were appropriately similar to the IDAT patient group, beyond the ED and hospital criteria, a comparison on patient 'complexity' was undertaken. That is, despite an excellent match on ED and hospital criteria in the year before treatment, were there differences in the medical, psychological or social complexity of the two patient groups. The details of a newly

[3] Note: the pool of potential pool from which to draw the control group already includes alcohol/drug dependence, and past AOD treatment within the reference period.

created complexity score, calculated for the 12 months prior to index treatment, can be found in Appendix 2.

The results of the complexity score shows that the two groups were not significantly different in terms of their medial, psychological or social complexity (t=-0.62; p=0.53). This gives us confidence that the sample selected for the control group is comparable on the key variables of interest to those who received IDAT. In applying this method, however, it does not control for differences in age, gender, principal drug of concern, or the number of previous AOD treatment admissions. In order to deal with this limitation, these variables were included in the mixed effects regression analyses in order to manage any differences on these variables between the IDAT and the control groups.

Final Sample for the Study Population

All HSU records were available for 277 IDAT patients and 277 control patients during the 12 months pre index treatment. However, during 12 months post index treatment, 20 IDAT patients and 14 control patients died (data extracted from the records of the NSW Mortality Data). The full sample (277 for IDAT and 277 for the control group) was used for comparing mortality rate between the two groups. However, for comparing emergency department and hospital admissions data, those patients who had died were excluded from those analyses (resulting in n=257 for IDAT patients and n=263 for the control patients).

Costing method

Costing data for both hospital services and emergency services were downloaded from Independent Hospital Pricing Authority (IHPA)'s website[4].

Hospital costing

The established method for costing hospital care in Australia [1, 2] uses three items to estimate hospital costs: 1) the Australian Refined-Diagnosis Related Groups (AR-DRGs); 2) episode of care LOS; and 3) episode of care type (e.g. acute, nonacute). For the APDC data in this evaluation, 98.3% of the hospital records were in the acute care category, therefore, we only used the two first items to estimate hospital cost for this project.

Estimates of hospital costs were obtained from national hospital costing estimates. Using estimates of public hospital costs [3], the average daily cost per AR-DRG was multiplied by the patient-specific episode of care LOS up to 120 days; then, a flat rate of $200 per day was applied. The average cost per AR-DRG included costs for medical and nursing clinical services, non-clinical salaries, pathology, imaging, allied health, pharmaceuticals, intensive and coronary care, operating rooms, emergency departments, supplies and ward overheads, specialist procedure suites, prostheses, staff on-costs (e.g. superannuation, termination, long-service leave, workers' compensation, recruitment costs), cleaning, linen and food services and depreciation costs [1, 2]. For patients treated at a private hospital, the average daily public hospital AR-DRG costs were used as estimates of cost.

[4] As part of the *National Health Reform Act 2011*, IHPA was established by the Australian Government to provide independent advice about the efficient cost of public hospital services. IHPA's primary role is to deliver a National Efficient Price (NEP) and price weights for various groups of activities in public hospitals, including EDs.

The mechanics of the costing calculation for one hospital admission is presented with one specific example as below:

Table 2: Hospital cost calculation example

Variable names and data source	Values
AR-DRG (from the APDC)	X62A (Poisoning/Toxic Effects of Drugs and Other Substances
Patient-specific episode LOS (from APDC)	6 (days)
Cost weight (from IHPA)	1.71
Average LOS for X62A (from IHPA)	1.21 (days)
DRG total cost = Cost weight X National Efficient Price for 2012-13 (AU$5,052)	= 1.71 x AU$5,052 = U$8,638.92
Daily cost per DRG = DRG total cost/ Average LOS for X62A	= AU$8,638.92/1.21 (days)= AU$7,139.60
Total cost for one patient-specific hospital admission = Daily cost per DRG X Patient-specific episode LOS	= AU$7,139.60 x 6 (days) = AU$42,837.60

AR-DRGs is a classification system used to calculate hospital funding on an activity basis, which relates the number and type of patients treated in a hospital to the resources required by the hospital. AR-DRGs group patients with similar diagnoses requiring similar hospital services. Episodes of admitted acute care are assigned with disease and intervention codes by health information managers or clinical coders. This process of assigning patient episodes to an AR-DRG is carried out using software that contains the AR-DRG algorithms [4, p. 5]. For this project, the APDC data included the AR-DRG version 6.0x (representing the version used in 2012-13, NHCDC round 17) as submitted by state and territory governments to the National Hospital Cost Data Collection (NHCDC). While the latest DRG version (V10.0) is considered the best reflection of clinical practice, analysis of the specific AR-DRGs (conditions and procedures) showed a material change of 10% between two subsequent version [4, p. 5]. Therefore, we mapped the AR-DRG codes with the cost weights for 2012-2013 (i.e. all costs are in 2012-2013 Australian dollars).

ED costing

There are two classification systems for costing emergency services in Australia: 1) Urgency Disposition Groups (UDGs); and 2) Urgency Related Groups (URGs). UDGs group patient presentations on the basis of the: 1) type of visit; 2) triage; and 3) mode of separation, whereas URGs group patient presentations on the basis of: 1) type of visit; 2) triage; 3) mode of separation; and 4) diagnosis (represented by a major diagnostic block (MDB)). The main difference between these two classification systems is that URGs use an additional category to further identify similar patient presentations when compared to UDGs (i.e. major diagnostic blocks) [5].

For this study, we adopted the UDG classification system to cost ED services because the major diagnostic block (MDB) variable is currently not available in the NSW EDDC (because the MDB is only used for emergency departments, not emergency services). Further, 97.3% of the EDDC records had the visit type of “emergency presentation”, therefore we only used two items (triage and mode of separation) for costing.

Specifically, UDG categorises the data based on triage scale (Category 1 = Most urgent, Category 5 = Least urgent) and departure status (Admitted, Discharged). This creates ten groups (UDG-1 = Admitted, Triage-1 to UDG-10 = Discharged, Triage-5) plus two extra groups for patients who were “dead on arrival” or “did not wait”. Each UDG is assigned a price weight that when multiplied by the

NEP, the cost for that group is determined. The price weights and NEPs are determined by IHPA as outlined in the *Pricing Framework for Australian Public Hospital Services*, and are updated annually.

To be consistent with the costing of hospital care, the price weights and NEPs for 2012-2013 were also used for costing ED services. In 2012-13, the NEP was set at AU$4808, and the price weights (PW) and estimated cost for each UDG were [6, p. 3]:
1. UDG-1 = Admitted, Triage 1, PW: 0.2996, estimated cost: AU$1440.5;
2. UDG-2 = Admitted, Triage 2, PW: 0.2061, estimated cost: AU$990.9
3. UDG-3 = Admitted, Triage 3, PW: 0.1801, estimated cost: AU$865.9
4. UDG-4 = Admitted, Triage 4, PW: 0.1531, estimated cost: AU$736.1
5. UDG-5 = Admitted, Triage 5, PW: 0.1165, estimated cost: AU$560.1
6. UDG-6 = Non-Admitted, Triage 1, PW: 0.2203, estimated cost: AU$1059.2
7. UDG-7 = Non-Admitted, Triage 2, PW: 0.1475, estimated cost: AU$709.2
8. UDG-8 = Non-Admitted, Triage 3, PW: 0.1136, estimated cost: AU$546.2
9. UDG-9 = Non-Admitted, Triage 4, PW: 0.0768, estimated cost: AU$369.3
10. UDG-10 = Non-Admitted, Triage 5, PW: 0.0477, estimated cost: AU$229.3
11. UDG-11 = Did Not Wait, PW: 0.0353, estimated cost: AU$169.7
12. UDG-12 = Dead on Arrival, PW: 0.0440, estimated cost: AU$211.6

Data analyses

All statistical analyses were performed using the computing environment R [7]. Descriptive analyses were initially carried out comparing the two groups across a range of factors: 1) demographic characteristics; 2) clinical characteristics; and 3) HSU related pre-treatment variables.

For comparing mortality rate between the two groups, Cox proportional hazards regression analysis (an extension of survival analysis) was used. Cox proportional hazards regression (using the function coxph(Surv(time, status) in R) works for both quantitative covariate variables and categorical variables. It extends survival analysis methods to assess simultaneously the effect of several risk factors (group variables and other covariates) on survival time (within 12 months post index treatment).

For comparing each of the HSU-related outcomes between the two groups, the mixed effects regressions method was used. Mixed effects regressions method is an extension of the repeated-measures analysis for general linear models. This method allows examination of baseline differences between groups, as well as change within and between groups using a single analytic framework and has the flexibility to allow non-normal distributions of the error terms. In these models, each observation represents a person at a given time, using two records per person as representing the two measurement points (12-month pre and 12-month post index treatment). The correlation between repeated measures (pre and post) is accounted for but treated as a "nuisance parameter". Therefore, we modelled the marginal distribution of outcome for each time period rather than the conditional distribution of posttreatment values given baseline data.

The lmer function in the lme4 package for R (fitting *Linear Mixed-Effects Models - LMM*) was used to conduct analysis for continuous outcome variables (number of hospital admissions, number of ED visits, cumulative number of hospital LOS, cumulative hospital cost, and cumulative ED cost). The glmer function (with a logit link function) in the lme4 package for R (fitting *Generalized Linear Mixed-Effects Models (GLMM)*) was used to conduct analysis for dichotomous outcome variables (ED visits 12 months after index treatment yes/no, hospital admission 12 months after index treatment yes/no).

All of the 5 continuous outcome variables listed above are not normally distributed therefore did not meet the required assumptions for *LMM* for the estimates to be valid (this is confirmed by the model diagnostics results). This problem was overcome by log transforming these continuous outcome variables making. After log transformation, the model diagnostics results confirm that the required assumptions for *LMM* were met for 3 outcome variables (number of hospital admissions, number of ED visits, cumulative number of hospital LOS). However, this was not the case for the two variables on total cost. This is a common challenge working with cost data because cost data are more heavily skewed to the right and have many zeros. Therefore, *GLMM* with a log link function and a gamma distribution were used to model cost data outcomes. *GLMM* allows more flexible modelling of costs that is superior to *LMM* of log cost. *GLMM* allows inclusion of observations with zero cost. Model diagnostics were conducted after fitting each outcome to confirm the robustness of the model estimates.

As with any data linkage study, a substantial amount of time is often given to the initial data cleaning and data processing to prepare the data in a format ready for the data analyses. Detailed description of the data cleaning and data processing is presented in Appendix 7.

Sample characteristics

Tests of significance comparing the demographic, clinical and 12-month pre-treatment variables show that the two groups were largely identical. As per the applied matching method to create the control group, there were no group differences on ED presentations and hospital admissions at pre-treatment.

Six variables showed statistically significant differences between the two groups: 1) age; 2) sex; 3) living arrangement; 4) type of usual accommodation; 5) principle drug of concern; and 6) number of AOD treatment episodes in the 12 months post index treatment. Age, sex, principal drug of concern, and number of AOD treatment episodes post index treatment were included as covariates in the final data analysis. A new variable, homelessness (dichotomised) was created to represent living arrangement/type of usual accommodation in order to also control for this in the analyses.

Table 3: Profile of the IDAT patients and the control group (pre index treatment)

Characteristics	**IDAT patients (n=257)[1]**	**Control patients (n=263)**	**Test of significance**
Demographics			
Mean age (SD)	44.3 (10.6)	41.77 (10.2)	t = -2.47; p=0.01
Male, *n* (%)	52.5	66.0	X^2 = 8.90; p=0.003
Marital status (%)			
Married/de facto	25.1	27.9	X^2 = 1.59; p=0.21
Single	61.2	59.6	
Other	13.7	12.5	
Principal source of income (%)			
Wage/salary	0.06	0.05	X^2 = 5.52; p=0.06
No income	0.85	0.79	
Government pension, allowance or benefit	0.09	0.15	
Living arrangement (%)			
Living alone	0.50	0.40	X^2 = 20.48; p<0.001
Parents' home	0.19	0.11	
With others	0.22	0.32	
Unknown	0.07	0.14	
Type of usual accommodation (%)			
Renting	0.46	0.53	X^2 = 8.91; p=0.03
Privately owned	0.26	0.15	
Public housing	0.07	0.08	
Homeless or unknown	0.20	0.22	
AOD use and other clinical behaviours			
Principal drug of concern			
Alcohol	0.83	0.69	X^2 = 14.61; p<0.001
Stimulants (meth/amphetamine)	0.11	0.15	
Other drugs	0.06	0.15	
Number of AOD treatment episodes 12 months post index treatment[2]	2.98 (4.47)	1.99 (3.19)	t = -2.89; p=0.004
Complexity score (pre index treatment)[3]	5.97 (3.77)	5.76 (3.98)	t = -0.62; p=0.53
12 months pre index treatment			
<u>*Hospital Admission:*</u>			
Proportion of people having at least one hospital admission	84.0	84.1	X^2 = 0; p=1.00
Number of hospital admissions	5.05 (5.18)	4.97 (4.69)	t = -0.18; p=0.86
Cumulative hospital LOS	22.59 (22.48)	20.06 (27.92)	t = -1.09; p=0.27
Cumulative hospital cost	AU$51,507 (AU$100,235)	AU$49,942 (AU$102,381)	t = -0.18; p=0.86
<u>*ED visit:*</u>			
Proportion of people having at least one ED visit	71.5	71.9	X^2 = 0; p=1.00
Number of ED visits	4.12	4.00	t = -0.22; p=0.82
Cumulative ED cost	AU$2,738 (AU$4,288)	AU$2,633 (AU$3,654)	t = -0.30; p=0.76

Notes:

1. This table excludes people who had died.
2. of the 257 IDAT patients, 32 patients (11.6%) had at least one repeated treatment episodes during the 12 months post IDAT index treatment (first episode).
3. Comorbidity has been shown to be one of the important predictors of treatment effects in drug and alcohol treatment. Therefore, in this study, a "complexity score" was created that comprised three elements: physical comorbidity, psychological comorbidity, and social comorbidity (see appendix 3).

RESULTS

Mortality rate

Table 4 shows the mortality proportion during the 12 months post index treatment for the IDAT group at 7.3% (20 of the full original sample of 277) and for the control group 5.1% (14 of the full original sample of 277).

Table 4: Mortality during 12 months post index treatment: Proportion Yes/No

	12-month POST index treatment
IDAT (n=277)	
Number of people died	20
Mortality proportion	7.3%
CONTROL (n=277)	
Number of people died	14
Mortality proportion	5.1%

The output of the Cox proportional hazard regression analysis (Table 5) showed that there was no statistically significant difference in the hazard ratio (for mortality rate) between the two groups. Controlling for gender, age, number of AOD treatment episodes after index treatment, and principal drug of concern (all of which were not significant, see Table 5), there was no difference between the two groups in mortality rate.

Table 5: Cox proportional hazard regression analysis with mortality: full sample (277 IDAT cases, and 277 control cases)

Predicting variables	**Beta Coefficient (standard error)**	**Hazard Ratio (HR) = exp(beta)**	**95% Confidence Intervals (for the HR)**	**P-value**
Group				
IDAT	1.18 (0.36)	1.20	0.59; 2.45	0.61
Control (reference)	--	--	--	--
Sex				
Female	-0.35 (0.39)	0.70	0.33; 1.49	0.36
Male (reference)	--	--	--	--
Age	-0.05 (0.02)	1.05	1.02; 1.09	0.39
Number of AOD treatment episodes 12 months post index treatment	-0.006 (0.04)	0.99	0.91; 1.09	0.89
Principal drug of concern				
Stimulant	-0.69 (1.05)	0.49	0.06; 3.90	0.52
Other drugs[1]	-0.71 (1.03)	0.49	0.06; 3.74	0.49
Alcohol (reference)	--	--	--	--

Note:
1. Other drugs: includes opioids (heroin, methadone, pharmaceutical opioids), benzodiazepines, cannabis, or not specified.

Emergency care related outcomes

Proportion of people reporting at least one ED visits

As planned for in matching the IDAT group with a suitable control group, Table 6 shows that during the 12 months pre index treatment, the proportion of IDAT patients having at least one ED visit was 71.5% and it was 71.9% in the control group. This proportion was reduced to 51.8% for IDAT and 46.4% for the control group during the 12 months post index treatment.

Table 6: ED Visits: Proportion YES/NO (deaths removed)

	12-month PRE	**12-month POST**
IDAT (n=257)		
Total number of patients with at least one ED visit	184	133
Proportion	71.5%	51.8%
CONTROL (n=263)		
Total number of patients with at least one ED visit	189	122
Proportion	71.9%	46.4%

To test whether there were any statistically differences between IDAT and control groups on this outcome variable (and all the ones that follow), mixed effects regression analyses were used. For the results in Table 7 (below) and all the following mixed effect regression analyses tables, the most important variable is the interaction term (Group*Time) which, if significant, shows that there was a significant difference in the rate of change on the outcome variable between the two treatment groups. This interaction term controls for other important variables (as per tables below: age, gender, principal drug of concern, treatment episodes received after index treatment, and homelessness). These same covariates are used in all the following analyses.

Table 7 shows the output of the mixed effects regression analysis examining the proportion of people in the IDAT and control groups who had at least one ED visit at pre and at post index treatment. The significant effect of "Time" (which assess change in the IDAT group), indicates that the probability of having at least one ED visit was reduced by 84% (1-0.16) on average for the IDAT group, after controlling for all other variables and their interaction terms. The non-significant effect of "Group" indicates that there was no statistically significant difference in the probability of having at least one ED visit for the IDAT and the control groups at pre-treatment. Having examined change over time for IDAT and establishing no difference between IDAT and control at pre-index treatment, the interaction term (Group*Time) then allows us to test whether the two groups differed in the rate of change between pre and post index treatment. The result is not statistically significant. Both groups, on average reduced the likelihood of an ED visit (for IDAT the reduction was by 84% and for the control group the reduction was 88% (1-0.12)[5] and the difference in the rate of change between the two groups was not statistically significant.

[5] 0.16 x 0.77 = 0.12

Table 7: Mixed effects regression analysis with ED visits: Proportion YES/NO as outcome variable (257 IDAT cases, and 263 control cases)

Predicting variables	**Odds Ratio (OR)**	**95% Confidence Intervals (for the OR)**	**P-value**
Time (IDAT)	0.16	0.04 – 0.63	0.009
Group			
Control	1.18	0.66 – 2.10	0.569
IDAT (reference)	--	--	--
Group*Time			
Control*Time	0.77	0.39 – 1.54	0.465
IDAT*Time (reference)	--	--	--
Age (rescaled every 10 years)[1]	1.01	0.80 – 1.26	0.947
Age*Time	1.04	0.79 – 1.36	0.783
Gender			
Male	1.73	0.98 – 3.06	0.060
Female (reference)	--	--	--
Gender*Time			
Male*Time	0.76	0.38 – 1.51	0.428
Female*Time (reference)	--	--	--
Principal drug of concern			
Stimulant	0.12	0.05 – 0.31	<0.001
Other drugs[2]	0.16	0.06 – 0.40	<0.001
Alcohol (reference)	--	--	--
Principal drug of concern*Time			
Stimulant*Time	1.27	0.42 – 3.84	0.669
Other drugs*Time	3.30	1.09 – 10.00	0.035
Alcohol*Time (reference)	--	--	--
Tx Episodes[3]	1.12	1.02 – 1.22	0.015
Tx Episodes*Time	1.12	1.00 – 1.25	0.052
Homelessness			
Homeless	1.60	0.78 – 3.26	0.197
Not homeless (reference)	--	--	--
Homelessness*Time			
Homeless*Time	1.58	0.67 – 3.72	0.292
Not homeless*Time (reference)	--	--	--

Notes:

1. Age was rescaled to intervals of 10 years to allow convergence of mixed effects regressions models
2. Other drugs: includes opioids (heroin, methadone, pharmaceutical opioids), benzodiazepines, cannabis, or not specified.
3.Tx Episodes: Number of AOD treatment episodes 12 months post index treatment.

Overall note: All covariates and their respective interaction terms have been included in the model. However, the significance testing for the covariates pertains to whether the covariate is associated with the outcome, not whether it differentiates IDAT from control. As a result, they are not central to our focus on examining whether there were differences between IDAT and control group outcomes. The objective of including the covariates and their interaction terms in the model is to ensure a more precise estimates of Time and the interaction term Group*Time.

Number of ED visits

Table 8 shows that, as planned for in the matching of IDAT with controls, during the period of 12 months pre index treatment, IDAT patients had a mean of 4.12 ED visits compared to 4.00 ED visits among the control group. The number of ED visits were reduced for both groups during the 12 months post index treatment (mean of 2.69 for IDAT patients and 2.45 for control patients).

Table 8: Total number of ED visits 12 months pre and 12 months post index treatment

	12-month PRE	**12-month POST**
IDAT (n=257)		
Mean (SD)	4.12 (6.52)	2.69 (5.85)
Median (min-max)	2 (0 - 51)	1 (0 - 51)
CONTROL (n=263)		
Mean (SD)	4.00 (5.80)	2.45 (6.55)
Median (min-max)	2.0 (0 - 43)	0.0 (0 - 71)

Table 9 shows the output of the mixed effects regression analysis comparing the two groups in the change (reduction) in the number of ED visits between 12 months pre and post index treatment. The effect of Time is significant (with an estimate/beta coefficient value of -0.19[6]) indicating that the number of ED visits was reduced by 19% on average for the IDAT group at 12-month post compared to 12-month pre index treatment, after controlling for all other variables and their interaction terms. The non-significant effect of "Group" indicates that there was no statistically significant difference in the number of ED visits between the IDAT and the control groups at pre-treatment. There was also no significant difference in the rate of reduction between the two groups over time: the interaction term "Group*Time" was not statistically significantly different between the two groups. Both groups achieved a reduction in the number of ED visits between 12 months and post index treatment (with a reduction rate of 19% for IDAT and 23%[7] for the control group). .

Table 9: Mixed effects regression analysis with the natural log of "number of ED visits" as outcome variable (257 IDAT cases, and 263 control cases)

Predicting variables	**Estimate/Beta Coefficient (of log transformed model)**	**95% Confidence Intervals (for the Estimate)**	**P-value**
Time (IDAT)	-0.19	-0.32 – -0.06	0.003
Group			
Control	0.05	-0.02 – 0.12 --	0.149
IDAT (reference)	--		--
Group*Time			
Control*Time	-0.04	-0.32 - -0.06	0.231
IDAT*Time (reference)	--	--	--
Age (rescaled every 10 years)[1]	0.01	-0.01 – 0.04	0.323
Age*Time	-0.01	-0.04 – 0.01	0.377

[6] Because the outcome data was log transformed, the interpretation of the estimate/beta coefficient follows that one unit change in the predictor leads to a beta X 100% change in the outcome. https://stats.stackexchange.com/questions/2142/linear-regression-effect-sizes-when-using-transformed-variables

[7] (-0.19)+(-0.04)=-0.23

Predicting variables	Estimate/Beta Coefficient (of log transformed model)	95% Confidence Intervals (for the Estimate)	P-value
Gender			
Male	0.06	-0.00 – 0.13	0.066
Female (reference)	--	--	--
Gender*Time			
Male*Time	-0.00	-0.07 – 0.06	0.920
Female*Time (reference)	--	--	--
Principal drug of concern			
Stimulant	-0.34	-0.45 – -0.24	<0.001
Other drugs[2]	-0.29	-0.41 – -0.18	<0.001
Alcohol (reference)	--	--	--
Principal drug of concern*Time			
Stimulant*Time	0.08	-0.02 – 0.19	0.120
Other drugs*Time	0.14	0.03 – 0.26	0.010
Alcohol*Time (reference)	--	--	--
Tx Episodes[3]	0.02	0.01 – 0.03	<0.001
Tx Episodes*Time	0.02	0.01 – 0.02	<0.001
Homelessness			
Homeless	0.09	0.01 – 0.17	0.028
Not homeless (reference)	--	--	--
Homelessness*Time			
Homeless*Time	0.03	-0.05 – 0.10	0.493
Not homeless*Time (reference)	--	--	--

Notes:

1. Age was rescaled to intervals of 10 years to allow convergence of mixed effects regressions models
2. Other drugs: includes opioids (heroin, methadone, pharmaceutical opioids), benzodiazepines, cannabis, or not specified.
3.Tx Episodes: Number of AOD treatment episodes 12 months post index treatment.

Overall note: All covariates and their respective interaction terms have been included in the table. However, the significance testing for the covariates pertains to whether the covariate is associated with the outcome, not whether it differentiates IDAT from control. As a result, they are not central to our focus on examining whether there were differences between IDAT and control group outcomes. The covariates and their interaction terms are included in the model to ensure a more precise estimates of Time and the interaction term Group*Time.

Cumulative ED cost

The study also examined whether there were any differences in the cumulative cost of ED visits in the year before and the year after index treatments, for both groups. Table 10 shows that during the period of 12 months pre index treatment, the mean cumulative ED cost incurred by IDAT patients was AU$2,738 and this was AU$2,633 for the control group. The cumulative ED cost was reduced for both groups during the 12 months post index treatment (mean of AU$1,688 for IDAT patients and AU$1,528 for control patients).

Table 10: Cumulative ED cost for all ED visits 12 months pre and 12 months post index treatment

	12-month PRE	**12-month POST**
IDAT (n=257)		
Mean (SD)	AU$2,738 (AU$4,288)	AU$1,688 (AU$3,709)
Median (min-max)	AU$1,235 (AU$0 - AU$34,532)	AU$369 (AU$0 - AU$30,324)
CONTROL (n=263)		
Mean (SD)	AU$2,633 (AU$3,654)	AU$1,528 (AU$3,701)
Median (min-max)	AU$1,418 (AU$0 - AU$27,644)	AU$0 (AU$0 - AU$36,873)

Table 11 shows the outputs of the mixed effects regression analysis comparing the two groups in the change (reduction) in the cumulative ED cost between 12 months pre and post index treatment. The ED costs for the IDAT group were reduced by 68% ((1-0.32) x 100%) (as indicated by the "Time" estimate/beta coefficient) controlling for all covariates and their interactions. The control group also reduced their ED costs by 71% (1-0.29)[8]. However, the difference in the rate of change was not statistically different between the two groups (as indicated by the non-significant effect of Group*Time).

Table 11: Mixed effects regression analysis with "cumulative ED cost" as outcome variable (257 IDAT cases, and 263 control cases)

Predicting variables	**Estimate/Beta Coefficient (exponentiated)[4]**	**95% Confidence Interval (for the exponentiated estimate)**	**P-value**
Time (IDAT)	0.32	0.19 – 1.61	<0.001
Group			
Control	1.22	0.93 – 1.61	0.153
Group (reference)	--	--	--
Group*Time			
Control*Time	0.90	0.67 – 1.21	0.482
IDAT*Time (reference)	--	--	--
Age (rescaled every 10 years)[1]	1.01	0.91 – 1.12	0.873
Age*Time	1.02	0.91 – 1.14	0.702
Gender			
Male	1.19	0.90 – 1.56	0.221
Female (reference)	--	--	--
Gender*Time			
Male*Time	1.02	0.76 – 1.38	0.874
Female*Time (reference)	--	--	--
Principal drug of concern			
Stimulant	0.25	0.16 – 0.39	<0.001

[8] 0.32 x 0.90 = 0.29

Predicting variables	Estimate/Beta Coefficient (exponentiated)[4]	95% Confidence Interval (for the exponentiated estimate)	P-value
Other drugs[2]	0.27	0.17 – 0.43	<0.001
Alcohol (reference)	--	--	--
Principal drug of concern*Time			
Stimulant*Time	1.12	0.69 – 1.83	0.640
Other drugs*Time	1.70	1.03 – 2.81	0.038
Alcohol*Time (reference)	--	--	--
Tx Episodes[3]	1.06	1.03 – 1.10	<0.001
Tx Episodes*Time	1.07	1.03 – 1.11	<0.001
Homelessness			
Homeless	1.43	1.03 – 1.98	0.031
Not homeless (reference)	--	--	--
Homelessness*Time			
Homeless*Time	1.11	0.78 – 1.57	0.566
Not homeless*Time (reference)	--	--	--

Notes:
1. Age was rescaled to intervals of 10 years to allow convergence of mixed effects regressions models
2. Other drugs: includes opioids (heroin, methadone, pharmaceutical opioids), benzodiazepines, cannabis, or not specified.
3.Tx Episodes: Number of AOD treatment episodes 12 months post index treatment.
4. As explained in the Data Analyses section, Generalized Mixed Effects Model with Gamma distribution and Log link was used for modelling costs data outcome, before interpreting the results, the estimates/beta coefficients were exponentiated to derive a multiplicative *increase* (value>1) (for a *positive* original value of beta coefficient) or a multiplicative *decrease* (value<1) (for a *negative* original value of beta coefficient) per unit of change in the predictor. https://stats.stackexchange.com/questions/431120/how-to-interpret-parameters-of-glm-output-with-gamma-log-link
Overall note: All covariates and their respective interaction terms have been included in the model. However, the significance testing for the covariates pertains to whether the covariate is associated with the outcome, not whether it differentiates IDAT from control. As a result, they are not central to our focus on examining whether there were differences between IDAT and control group outcomes. The objective of including the covariates and their interaction terms in the model is to ensure a more precise estimates of Time and the interaction term Group*Time.

Hospital care related outcomes

Having examined ED visits, we now turn to the second set of outcomes, unplanned hospitalisations.

Proportion of people having at least one unplanned hospital admission

As planned for in matching the IDAT group with a suitable control group, Table 12 shows that during the 12 months pre index treatment, the proportion of IDAT patients having at least one unplanned hospital admission was 84.0% compared to 84.1% in the control group. This proportion was reduced to 59.5% for IDAT and 45.9% for the control group during the 12 months post index treatment.

Table 12: Unplanned hospital admission: Proportion Yes/No

	12-month PRE	12-month POST
IDAT (n=257)		
Total number of patients with at least one unplanned hospital admission	216	153
Proportion	84.0%	59.5%
CONTROL (n=263)		
Total number of patients with at least one unplanned hospital admission	349	223
Proportion	84.1%	45.9%

Examining whether these changes across both the IDAT and groups were significantly different, Table 13 shows the output of the mixed effects regression analysis. There was a significant effect for Time, showing that the IDAT participants had a statistically significantly lower proportion of people being admitted to hospital after index treatment than before (with a reduction of 81% (1-0.19) x 100%). This did not differ between IDAT and controls before index treatment, as shown by the non-significant Group variable. Finally, the interaction term (Group*Time), testing whether the rate of change between the two groups was different, did not reach significance controlling for all the covariates (81% for IDAT and 86% (1-0.14)[9] for the control group).

Table 13: Mixed effects regression analysis with Hospital Admissions: Proportion YES/NO as outcome variable (257 IDAT cases, and 263 control cases)

Predicting variables	Odds Ratio (OR)	95% Confidence Intervals (for the OR)	P-value
Time (IDAT)	0.19	0.09 – 0.39	<0.001
Group			
Control	1.32	0.69 – 2.53	0.379
IDAT (reference)	--	--	--
Group*Time			
Control*Time	0.76	0.36 – 1.63	0.450
IDAT*Time (reference)	--	--	--
Age (rescaled every 10 years)[1]	1.26	0.98 – 1.63	0.073
Age*Time	0.91	0.67 – 1.23	0.535
Gender			
Male	0.73	0.38 – 1.40	0.346
Female (reference)	--	--	--
Gender*Time			
Male*Time	2.25	1.05 – 4.84	0.038
Female*Time (reference)	--	--	--
Principal drug of concern			
Stimulant	1.00	0.35 – 2.86	0.997
Other drugs[2]	0.21	0.09 – 0.50	<0.001
Alcohol (reference)	--	--	--
Principal drug of concern*Time			
Stimulant*Time	0.42	0.12 – 1.44	0.168
Other drugs*Time	2.80	0.96 – 8.17	0.060
Alcohol*Time (reference)	--	--	--

[9] 0.19 x 0.76 = 0.14

Predicting variables	Odds Ratio (OR)	95% Confidence Intervals (for the OR)	P-value
Tx Episodes[3]	1.12	0.99 – 1.26	0.063
Tx Episodes*Time	1.14	0.99 – 1.33	0.075
Homelessness			
Homeless	2.50	0.98 – 6.36	0.055
Not homeless (reference)	--	--	--
Homelessness*Time			
Homeless*Time	0.57	0.20 – 1.63	0.294
Not homeless*Time (reference)	--	--	--

Notes:
1. Age was rescaled to intervals of 10 years to allow convergence of mixed effects regressions models
2. Other drugs: includes opioids (heroin, methadone, pharmaceutical opioids), benzodiazepines, cannabis, or not specified.
3.Tx Episodes: Number of AOD treatment episodes 12 months post index treatment.

Overall note: All covariates and their respective interaction terms have been included in the model. However, the significance testing for the covariates pertains to whether the covariate is associated with the outcome, not whether it differentiates IDAT from control. As a result, they are not central to our focus on examining whether there were differences between IDAT and control group outcomes. The objective of including the covariates and their interaction terms in the model is to ensure a more precise estimates of Time and the interaction term Group*Time.

Number of unplanned hospital admissions

Turning to the number of unplanned hospital admissions, Table 14 shows that during the period of 12 months pre index treatment, IDAT patients had a mean of 5.05 unplanned hospital admissions and this was 4.97 for the control group, very similar as planned for in the matching process. The number of unplanned hospital admissions was reduced for both groups during the 12 months post index treatment (mean of 2.93 for IDAT patients and 2.87 for control patients).

Table 14: Total number of hospital admissions 12 months pre and 12 months post index treatment

	12-month PRE	12-month POST
IDAT (n=257)		
Mean (SD)	5.05 (5.18)	2.93 (4.91)
Median (min-max)	4.0 (0 - 31)	1.0 (0 - 32)
CONTROL (n=263)		
Mean (SD)	4.97 (4.69)	2.87 (4.79)
Median (min-max)	4.0 (0 - 31)	1.0 (0 - 31)

Table 15 shows the output of the mixed effects regression analysis comparing two groups in the change (reduction) in the number of unplanned hospital admissions between 12 months pre and post index treatment. The significant effect of "Time" indicates that the number of hospital admissions was reduced by 30% on average for the IDAT group at 12-month post compared to 12-month pre index treatment, after controlling for all other variables and their interaction terms. The two groups did not differ in the number of hospital admissions at pre-index treatment (non-significant "Group" term). The rate of change for the two groups was not statistically significantly different as shown in the Group*Time variable. This means that the rate of reduction in the number of hospital admissions, being 30% for IDAT and 31%[10] for controls was not different.

[10] (-0.30) + (-0.01) = -0.31

Table 15: Mixed effects regression analysis with the natural log of the "number of unplanned hospital admissions" as outcome variable (257 IDAT cases, and 263 control cases)

Predicting variables	**Estimate/Beta Coefficient (of log transformed model)**	**95% Confidence Intervals (for the Estimate)**	**P-value**
Time (IDAT)	-0.30	-0.43 – -0.17	<0.001
Group			
Control	0.04	-0.02 – 0.1102	0.182
IDAT (reference)	--	--	--
Group*Time			
Control*Time	-0.01	-0.08 – 0.06	0.750
IDAT*Time (reference)	--	--	--
Age (rescaled every 10 years)[1]	0.02	-0.00 – 0.04	0.111
Age*Time	-0.01	-0.04 – 0.01	0.335
Gender			
Male	0.02	-0.05 – 0.08	0.619
Female (reference)	--	--	--
Gender*Time			
Male*Time	0.06	-0.01 – 0.13	0.078
Female*Time (reference)	--	--	--
Principal drug of concern			
Stimulant	-0.02	-0.13 – 0.09	0.704
Other drugs[2]	0.06	-0.05 – 0.17	0.298
Alcohol (reference)	--	--	--
Principal drug of concern*Time			
Stimulant*Time	-0.02	-0.13 – 0.09	0.704
Other drugs*Time	0.06	-0.05 – 0.17	0.298
Alcohol*Time (reference)	--	--	--
Tx Episodes[3]	0.02	0.01 – 0.03	<0.001
Tx Episodes*Time	0.02	0.01 – 0.03	<0.001
Homelessness			
Homeless	0.09	0.01 – 0.16	0.024
Not homeless (reference)	--	--	--
Homelessness*Time			
Homeless*Time	-0.02	-0.10 – 0.06	0.570
Not homeless*Time (reference)	--	--	--

Notes:

1. Age was rescaled to intervals of 10 years to allow convergence of mixed effects regressions models
2. Other drugs: includes opioids (heroin, methadone, pharmaceutical opioids), benzodiazepines, cannabis, or not specified.
3.Tx Episodes: Number of AOD treatment episodes 12 months post index treatment.

Overall note: All covariates and their respective interaction terms have been included in the model. However, the significance testing for the covariates pertains to whether the covariate is associated with the outcome, not whether it differentiates IDAT from control. As a result, they are not central to our focus on examining whether there were differences between IDAT and control group outcomes. The objective of including the covariates and their interaction terms in the model is to ensure a more precise estimates of Time and the interaction term Group*Time.

Cumulative hospital length of stay

IDAT patients had a mean cumulative unplanned hospital length of stay (LOS) of 22.6 days compared to 20.06 days for the control group in the 12 months before index treatment (see Table 16). The cumulative unplanned hospital LOS was reduced for both groups during the 12 months post index treatment (mean of 15.9 days for IDAT patients and 11.35 days for control patients).

Table 16: Cumulative hospital length of stay (LOS) for all hospital admissions 12 months pre and 12 months post index treatment

	12-month PRE	**12-month POST**
IDAT (n=257)		
Mean (SD)	22.6 (24.5)	15.9 (27.4)
Median (min-max)	16.0 (0 - 125)	3.0 (0 - 146)
CONTROL (n=263)		
Mean (SD)	20.06 (27.92)	11.35 (21.75)
Median (min-max)	13.0 (0 - 221)	2 (0 - 149)

Table 17 shows the output of the mixed effects regression analysis comparing two groups in the change (reduction) in the cumulative hospital LOS between 12 months pre and post index treatment. The significant effect of "Time" with an estimate/beta coefficient value of -0.43 indicates that the cumulative hospital LOS was reduced by 42% on average for the IDAT group at 12-month post compared to 12-month pre index treatment, after controlling for all other variables and their interaction terms with Time. The non-significant effect of "Group" indicates that there was no statistically significant difference in the cumulative hospital LOS between the IDAT and the control groups at pre-index treatment. Finally, as with all the other results, the Group*Time term was not statistically significant, revealing no differences between IDAT and the control group in the rate of reduction in hospital length of stay (for IDAT the rate of reduction was 42% and for the control group it was 43%[11]).

[11] (-0.42) + (-0.01) = -0.43

Table 17: Mixed effects regression analysis with the natural log of the "cumulative hospital LOS" as outcome variable (257 IDAT cases, and 263 control cases)

Predicting variables	**Estimate/Beta Coefficient (of log transformed model)**	**95% Confidence Intervals (for the Estimate)**	**P-value**
Time (IDAT)	-0.42	-0.67 – -0.17	0.001
Group			
Control	-0.02	-0.12 – 0.09	0.757
IDAT (reference)	--	--	--
Group*Time			
Control*Time	-0.01	-0.13 – 0.23	0.958
IDAT*Time (reference)	--	--	--
Age (rescaled every 10 years)[1]	0.04	0.00 – 0.09	0.041
Age*Time	-0.02	-0.07 – 0.03	0.442
Gender			
Male	0.02	-0.08 – 0.13	0.672
Female (reference)	--	--	--
Gender*Time			
Male*Time	0.06	-0.06 – 0.19	0.327
Female*Time (reference)	--	--	--
Principal drug of concern			
Stimulant	0.02	-0.15 – 0.20	0.781
Other drugs[2]	-0.22	-0.40 – -0.04	0.016
Alcohol (reference)	--	--	--
Principal drug of concern*Time			
Stimulant*Time	-0.21	-0.41 – 0.00	0.051
Other drugs*Time	0.00	-0.21 – 0.22	0.967
Alcohol*Time (reference)	--	--	--
Tx Episodes[3]	0.02	0.01 – 0.04	0.001
Tx Episodes*Time	0.04	0.02 – 0.05	<0.001
Homelessness			
Homeless	0.10	-0.03 – 0.22	0.142
Not homeless (reference)	--	--	--
Homelessness*Time			
Homeless*Time	-0.01	-0.16 – 0.14	0.899
Not homeless*Time (reference)	--	--	--

Notes:

1. Age was rescaled to intervals of 10 years to allow convergence of mixed effects regressions models
2. Other drugs: includes opioids (heroin, methadone, pharmaceutical opioids), benzodiazepines, cannabis, or not specified.
3.Tx Episodes: Number of AOD treatment episodes 12 months post index treatment.

Overall note: All covariates and their respective interaction terms have been included in the model. However, the significance testing for the covariates pertains to whether the covariate is associated with the outcome, not whether it differentiates IDAT from control. As a result, they are not central to our focus on examining whether there were differences between IDAT and control group outcomes. The objective of including the covariates and their interaction terms in the model is to ensure a more precise estimates of Time and the interaction term Group*Time.

Cumulative hospital cost

Table 18 shows that during the period of 12 months pre index treatment, the mean cumulative unplanned hospital cost incurred by IDAT patients was AU$51,507 and this was AU$49,942 for the control group. The cumulative unplanned hospital cost was reduced for both groups during the 12 months post index treatment (mean of AU$36,103 for IDAT patients and AU$23,722 for control patients).

Table 18: Cumulative hospital cost for all hospital admissions 12 months pre and 12 months post index treatment

	12-month PRE	**12-month POST**
IDAT (n=257)		
Mean (SD)	AU$51,507 (AU$100,235)	AU$36,103 (AU$86,886)
Median (min-max)	AU$22,680 (AU$0 - AU$992,313)	AU$3,756 (AU$0 - AU$606,240)
CONTROL (n=263)		
Mean (SD)	AU$49,942 (AU$102,381)	AU$23,722 (AU$65,244)
Median (min-max)	AU$17,961 (AU$0 - AU$643,387)	AU$2,439 (AU$0 - AU$626,927)

The final result table, Table 19, shows the output of the mixed effects regression analysis comparing two groups in the change (reduction) in the cumulative hospital cost between 12 months pre and post index treatment. As with all the other results, there was a significant effect of "Time": the cumulative hospital cost was reduced by 81% (1-0.19) for the IDAT group at 12-month post compared to 12-month pre index treatment, after controlling for all other variables and their interaction terms with "Time". There was no statistically significant difference between the two groups at pre index treatment on cumulative hospital costs (as indicated by "Group"). And the non-significant effect of the interaction term "Group*Time" indicates that there was no statistically significant difference in rate of reduction in the cumulative hospital cost between the IDAT and the control groups (with the IDAT group reducing by 81% and the control group by 83% (1-0.17))[12].

Table 19: Mixed effects regression analysis with "cumulative hospital cost" as outcome variable (257 IDAT cases, and 263 control cases)

Predicting variables	**Estimate/Beta Coefficient (exponentiated)**	**95% Confidence Interval (for the exponentiated estimate)**	**P-value**
Time (IDAT)	0.19	0.10 – 0.39	<0.001
Group			
Control	0.81	0.56 – 1.19	0.287
IDAT (reference)	--	--	--
Group*Time			
Control*Time	0.90	0.63 – 1.27	0.548
IDAT*Time (reference)	--	--	--
Age (rescaled every 10 years)[1]	1.14	0.99 – 1.33	0.076
Age*Time	0.95	0.82 – 1.08	0.427
Gender			
Male	1.00	0.68 – 1.46	0.992
Female (reference)	--	--	--
Gender*Time			

[12] 0.19 x 0.90 = 0.17

Predicting variables	Estimate/Beta Coefficient (exponentiated)	95% Confidence Interval (for the exponentiated estimate)	P-value
Male*Time	1.49	1.04 – 2.14	0.032
Female*Time (reference)	--	--	--
Principal drug of concern			
Stimulant	4.41	2.35 – 8.31	<0.001
Other drugs[2]	0.90	0.46 – 1.74	0.745
Alcohol (reference)	--	--	--
Principal drug of concern*Time			
Stimulant*Time	0.23	0.12 – 0.44	<0.001
Other drugs*Time	0.97	0.49 – 1.89	0.918
Alcohol*Time (reference)	--	--	--
Tx Episodes[3]	1.05	1.01 – 1.10	0.025
Tx Episodes*Time	1.15	1.11 – 1.20	<0.001
Homelessness			
Homeless	1.28	0.81 – 2.00	0.287
Not homeless (reference)	--	--	--
Homelessness*Time			
Homeless*Time	1.17	0.78 – 1.77	0.442
Not homeless*Time (reference)	--	--	--

Notes:

1. Age was rescaled to intervals of 10 years to allow convergence of mixed effects regressions models
2. Other drugs: includes opioids (heroin, methadone, pharmaceutical opioids), benzodiazepines, cannabis, or not specified.
3.Tx Episodes: Number of AOD treatment episodes 12 months post index treatment.

Overall note: All covariates and their respective interaction terms have been included in the model. However, the significance testing for the covariates pertains to whether the covariate is associated with the outcome, not whether it differentiates IDAT from control. As a result, they are not central to our focus on examining whether there were differences between IDAT and control group outcomes. The objective of including the covariates and their interaction terms in the model is to ensure a more precise estimates of Time and the interaction term Group*Time.

DISCUSSION

This study evaluated the effectiveness of the IDAT program against three important health-related outcomes: mortality, emergency department admissions, and unplanned hospital admissions. For the emergency department outcomes (measured in a number of ways) and unplanned hospital admissions (also measured in a number of different ways), the IDAT program was associated with significant decreases in utilisation of these health services and reduced costs in the 12 months after IDAT treatment. This is an indication of positive IDAT outcomes and parallels the pre-post outcome study findings.

However, when we compare the IDAT outcomes to a matched control group, the outcomes for IDAT patients over a 12-month period are not significantly different from a matched control. In this sense, the findings are not so optimistic. We hypothesised that the IDAT group, having received the intensive IDAT treatment program, would have improved health status (as reflected in lower ED and unplanned hospital admissions) compared to the control group who received treatment as usual. This did not appear to be the case.

Firstly, in relation to mortality, there was a high death rate in IDAT patients 12 months after IDAT treatment. Twenty people died in the 12 months after leaving IDAT, a rate of 7,220 per 100,000 (20/277*100,000). In the control group, the number of deaths was 14, and the rate 5,054 per 100,000. These were not statistically significantly different, even when age, sex, other AOD treatment episodes, and principal drug of concern were taken into account.

Secondly, the aim of programs such as IDAT is to reduce the likelihood of emergency department presentations after treatment is completed. Both the IDAT and control groups reduced the number of emergency department presentations in the year after treatment, which was positive. However, there were no significant differences between IDAT and control groups on the emergency department outcomes, including no statistically significant difference in the number of ED visits, in whether there were any ED visits, and in the costs associated with the ED visits. In summary, there was no advantage for the IDAT group in the 12 months after treatment with reference to emergency department presentations. The lack of statistically significant differences between IDAT and a matched group who were also frequent attenders at hospitals in the pre 12-month period, and received AOD treatment, but not IDAT, may be due to regression to the mean. For both groups a crisis likely precipitated presentation (to IDAT or to control index treatment) which then resolves, as seen in the decrease for both groups in ED presentations over the subsequent 12-month period.

Unplanned hospital admissions reflect health problems. There were no differences between the IDAT patients in the year following treatment and the controls in relation to unplanned hospital admissions. More specifically any unplanned hospital admission in the 12 months after treatment reduced for both the IDAT and the control groups. There was also a reduction for both groups in the number of unplanned hospital admissions, in the lengths of stay and in the costs, with no advantage for IDAT.

Strengths and limitations

The strength of this study is the comparison group; while many treatment evaluations can demonstrate improvements in health outcomes and substance use when pre-treatment is compared to post-treatment (as confirmed in our pre-post outcome evaluation of IDAT), the absence of a control or comparison group limits the usefulness of those findings. Here, we have a well-matched control group, allowing us to answer the question of whether the IDAT program results in

improvements over and above any improvements that occur in the absence of IDAT. The use of a control group is made possible through data linkage. (The alternative, randomising people to IDAT and not IDAT to create a control group is unethical). Data linkage also provides a large sample pool from which to draw the matched control group. In this study, the control group were matched on the number of ED presentations and unplanned hospital admissions in the year before index treatment. We also calculated a complexity score (reflecting three aspects of complexity – medical, psycho-social and psychological). There was no significant difference in complexity scores between the IDAT and the control groups in the year before index treatment, reinforcing that this was a well-matched study. Another strength of the study is the utilisation of multiple sources of administrative data to enable creation of a range of covariates that could then be controlled for in the analyses (for example the number of treatment episodes 12 months post index treatment). Utilisation of administrative data is a non-costly method that allows for measuring changes in outcomes across a wide range of HSU outcome measures.

This study also has limitations. First, there is uncertainty in the level of completeness of the data, especially the data related to the number of records and unique number of IDAT patients identified from the NSW MDS DATS. The systematic recording of the IDAT code (*70 – Involuntary D&A Treatment (IDAT)*) under the variable "Main Service Provided" was not officially introduced into the NSW MDS DATS until late 2014 while the actual implementation of the IDAT program started in May 2012. Therefore, additional codes of 20, 21 (old codes prior to 2014) and the codes of 11E535 and 11N537 (for the variable "Establishment_identifier", one for Royal North Shore Hospital and the other for Bloomfield Hospital, the two IDAT Treatment Units) were also used to identify records belonging to IDAT patients. As per the official analysis of the IDAT database in the IDAT Process Evaluation, 254 unique IDAT patients were in the database from the period of the start of the IDAT program (31 May 2012) to 24 June 2016 (4 years). This suggests that an average of 63 unique patients received IDAT per annum. As such, we expected to have a sample of approximately 380 unique IDAT patients for this data linkage study. While the original data received from CHeReL contained 385 IDAT patients (with 811 records), only 45% of these IDAT records had full personal identifiers (as informed by the CHeReL), which led to only 54.5% of the IDAT patients being identified in the APDC and only 54.3% being identified in the EDDC. As a result, working with CHeReL and the IDAT data custodians, manual entry of personal identifiers for 277 of the original 385 resulted the ability to link 97.1% of 277 IDAT patients with the APDC and 97.1% with the EDDC.

This means that some patients who did receive IDAT (around 100 patients) were not included in the data linkage study, due to the absence of personal identifiers allowing linkage. If we assume that these patients are not dissimilar to the 277 patients who were included in the data linkage, then the results will hold. There is no way of assessing whether there is any systematic bias in the absence of personal identifiers in the administrative data. For those patients who died (in both groups), they were excluded from the analyses comparing post 12-month treatment outcomes. It is possible that those who died had a different pattern of presentations in the time before death compared to those who did not die. However, in order for it to influence the overall findings, there would need to be differential patterns in those who died between the two groups. This seems unlikely.

There are other limitations inherent to all data linkage studies, relying as they do on administrative records created by clinicians or administrators during the course of service delivery. As a result some events may be mis-coded, and there may be data entry errors in the source data. We assume that any such errors are equally distributed between the two groups and as such would not influence the findings.

Conclusion

While IDAT is associated with reduced health service utilisation in the year following the IDAT treatment, the outcomes did not differ from those of a suitably matched control group. This suggests that, on these measures, there is no net advantage for IDAT as an intervention relative to treatment as usual.

REFERENCES

1. Mitchell RJ, Herkes G, Nikpour A, Bleasel A, Shih P, Vagholkar S, et al. Examining health service utilization, hospital treatment cost, and mortality of individuals with epilepsy and status epilepticus in New South Wales, Australia 2012-2016. Epilepsy & Behavior. 2018;79:9-16.
2. Kinchin I, Russell AM, Byrnes J, McCalman J, Doran CM, Hunter E. The cost of hospitalisation for youth self-harm: differences across age groups, sex, Indigenous and non-Indigenous populations. Social psychiatry and psychiatric epidemiology. 2019:1-10.
3. (IHPA) IHPA. National Hospital Cost Data Collection Australian Public Hospitals Cost Report 2012-2013, Round 17. 2013.
4. (NHPA) NHPA. Hospital Performance: Costs of acute admitted patients in public hospitals in 2011-12. Technical Supplement. 2012.
5. (IHPA) IHPA. Development of the Australian Emergency care classification. Public consultation paper. 2017.
6. Toloo GS, Hu W, FitzGerald G, Aitken P, Tong S. Projecting excess emergency department visits and associated costs in Brisbane, Australia, under population growth and climate change scenarios. Scientific reports. 2015;5:12860.
7. Rizzo ML. Statistical computing with R: Chapman and Hall/CRC; 2007.
8. Ho DE, Imai K, King G, Stuart EA. MatchIt: nonparametric preprocessing for parametric causal inference. Journal of Statistical Software, http://gking harvard edu/matchit. 2011.
9. Ho D, Imai K, King G, Stuart E, Whitworth A. Package 'MatchIt'. Version; 2018.
10. Shadish WR, Cook TD, Campbell DT. Experimental and quasi-experimental designs for generalized causal inference. Boston, MA: Houghton Mifflin; 2002.

APPENDICES

Appendix 1: Method for creating the covariate “treatment episodes”

Clinically, whether a patient had uptake of AOD treatment during the 12 months post index treatment has important implications on the outcome (mortality and HSU) post treatment. Therefore, a covariate variable named “treatment episodes” was created and controlled for in all the final analyses.

The NSW MDS DATS was used as the source data for creating this covariate in the following steps:

1. Using two variables: "service_end_date" for index treatment (see definition of index treatment in the Study Design section) and "service_start_date" of subsequent AOD treatment as usual (TAU) to create a variable "diff_in_days_POST", which is the difference in the number of days between the time of the two dates;
2. Choosing only records that have the value from 0 to 365 (days) (which means 12 months post index treatment). These are the rows/records that have TAU “service_start_date” later than IDAT “service_end_date”) and within 12 months;
3. Summing up the number of records per unique client to create the variable “treatment-episodes”, which is the number of AOD treatment episodes 12 months post index treatment for both groups. This variable was used as a covariate in all final analysis (Cox proportional hazard regressions model for comparing mortality rate and mixed effects regressions model for comparing HSU related outcomes between the two groups).

Appendix 2: Method for calculating "complexity score"

Comorbidity has been shown to be one of the important predictors of treatment effects in drug and alcohol treatment. Therefore, in this study, a "complexity score" was created that comprised three elements:

1. Physical comorbidity: in the APDC data collection, there is one variable "primary diagnosis" and 10 variables on "secondary diagnosis" for each hospital admission. A count of all secondary diagnosis (excluding diagnosis related to AOD/MH problems) for each hospital admission and then summed across all hospital admissions was used to represent a score for physical comorbidity;
2. Psychological comorbidity: In the MHADC (Mental Health) data collection, there is a variable named "diagnosis_code", which has 51 diagnosis codes for a wide range of conditions. A count of all diagnosis codes (excluding diagnosis 99.1-mental health diagnosis not yet allocated and 99.2-Mental Health Diagnosis not applicable) for multiple episodes for each unique patient was used to represent a total score for psychological comorbidity (see Appendix 8 for the list of mental health diagnosis codes).
3. Social comorbidity: any patient who was homeless was given a score of 1 for social comorbidity and any patient who was unemployed was given a 1 score for social comorbidity.

The total complexity score (for 12-month pre index treatment) was created by summing scores of all three elements. The frequency statistics are presented below.

Table A.1: Frequency statistics for total complexity score (12-months pre index treatment)

	Complexity score
IDAT (n=257)	
Mean (SD)	6.05 (3.79)
Median (min-max)	6 (0 - 16)
CONTROL (n=263)	
Mean (SD)	5.75 (3.97)
Median (min-max)	5 (0 - 22)

Appendix 3: List of ICD codes to filter APDC data and EDDC data

Table A.2: List of ICD codes

ICD codes	Description
F10.2	Mental and behavioural disorders due to use of alcohol, dependence syndrome
F10.0	Acute intoxication due to use of alcohol
F10.3	Mental and behavioural disorders due to use of alcohol, withdrawal state
F15.21	Other stimulant abuse, in remission
F15.51	Mental and behavioural disorders due to use of other stimulants, including caffeine: psychotic disorder
F10.1	Mental and behavioural disorders due to use of alcohol, harmful use
K85.2	Alcohol induced acute pancreatitis
F15.59	Mental and behavioural disorders due to use of other stimulants, including caffeine: psychotic disorder
F19.5	Mental and behavioural disorders due to multiple drug use and use of other psychoactive substances: Psychotic disorder
F19.1	Other psychoactive substance abuse
F19.2	Other psychoactive substance dependence
K70.3	Alcoholic cirrhosis of liver
F15.11	other stimulant abuse, in remission
F15.29	Mental and behavioural disorders due to use of other stimulants, including caffeine: dependence syndrome

Appendix 4: List of SNOMED-CT codes to filter EDDC data

Table A.3: List of SNOMED-CT codes

SNOMED codes	Description
191816009	Drug dependence (disorder)
25702006	Alcohol intoxication (disorder)
15167005	Alcohol abuse (disorder)
2403008	Psychoactive substance dependence (disorder)
191480000	Neurological disorder caused by ingestible alcohol (disorder)
66590003	Alcohol dependence (disorder)
361055000	Misuses drugs
191483003	Drug-induced psychosis (disorder)
191802004	Acute alcoholic intoxication in alcoholism (disorder)

Appendix 5: Specific steps to identify the "pool" for the control group

The research team undertook the following steps to identify the control group participants (after receiving the source data from the CHeReL):

Step 1: Absence of an IDAT record. The original data file received from the CHeReL has 79831 records (from the NSW MDS DATS). After taking out records that belong to the IDAT patients (by using the 277 IDAT PPN – project person number), we have 75546 records and this created list A.

Step 2: From list A, identifying patients who have had at least one "treatment as usual" D&A treatment episode from the NSW MDS DATS, with the "Main Services Provided" codes listed in the Inclusion Criterion 2 (in the Study Population section) between 1 May 2011 to 30 April 2018. This created List B, which has 27,892 records.

Step 3: From list B, identifying patients who have had an ICD-10-AM codeset F10.X for medical conditions as the result of the harmful use of alcohol or an ICD-10-AM codeset F15.X for medical conditions as the result of the harmful use of stimulants (meth/amphetamine) (or the equivalent SNOMED codes). See Appendices 3 and 4 for the full list of ICD codes for the APDC and the ICD codes and SNOMED codes for the EDDC. This created List C, which has 15,546 records, representing 8935 unique patients.

Step 4: From the list C (8935 unique patients), identifying those who had similar number of unplanned hospital admissions (identified via the APDC) and similar number of ED visits (identified via the EDDC) during a 12-month period prior to the date of the "service_start_date" of the first patient-specific "treatment as usual" episode. This was achieved by using the MatchIt software in R (using the underlying propensity score matching principles) [8, 9] . The "exact matching" option with 1:1 ratio matching was employed. Specifically, each IDAT patient was matched with a unique patient from the "pool" of the potential control group (8935 unique patients). As a result, 277 unique patients from this pool were matched to the 277 unique IDAT patients. This created List D, which was the final control group (n=277) for this evaluation. See Appendix 6 for further details on matching method.

Appendix 6: Propensity score matching to match control group to IDAT patients

The present study is quasi-experimental design [10] because it lacks random assignment, which can lead to imbalances between treatment groups. We used propensity scores to balance treatment and control groups on important variables to strengthen causal inferences. Propensity score matching is a statistical technique that has proven useful to evaluate treatment effects when using quasi-experimental or observational data. Propensity scores are defined as the conditional probability of assigning a unit to a particular treatment condition (i.e., likelihood of receiving treatment), given a covariate or a set of observed covariates. The propensity score then allows matching of individuals in the control and treatment conditions with the same likelihood of receiving treatment. We used propensity score ("nearest neighbour matching method") as the matching tool, and matching on a ratio of 1:1, that is creating a control group comprised of 277 controls.

For this project, there are a number of ways in which a suitable matched control group can be selected from the large potential pool of control participants. The control group could be matched on demographic and clinical characteristics (such as age, gender, principal drug of concern), and/or matched on whether they would have been likely recipients of IDAT, that is matched on the number of hospital admissions and emergency department admissions in the year preceding treatment[13]. Therefore, we conducted two matching options and then compared the results to make well-informed decision on the most suitable matching approach for this project.

Option 1: Matching on the following demographic, clinical and baseline HSU variables:

1. Age
2. Gender
3. Marital status
4. Principal drug of concern
5. Living arrangement
6. Type of usual accommodation
7. Principal source of income
8. Complexity score 12 months pre index treatment
9. Number of unplanned hospital admissions 12 months pre index treatment
10. Number of ED presentations 12 months pre index treatment

Option 2: Matching on the following baseline HSU variables:

1. Number of unplanned hospital admissions 12 months pre index treatment
2. Number of ED presentations 12 months pre index treatment

Below are the histograms and summary tables that compare the matching results of the two options.

[13] Note: the pool of potential pool from which to draw the control group already includes alcohol/drug dependence, and past AOD treatment within the reference period.

Results of option 1:

Figure A.1: Histogram: the number of ED visits 12 months pre index treatment for IDAT and matched control (1=IDAT, 0=control) (Option 1)

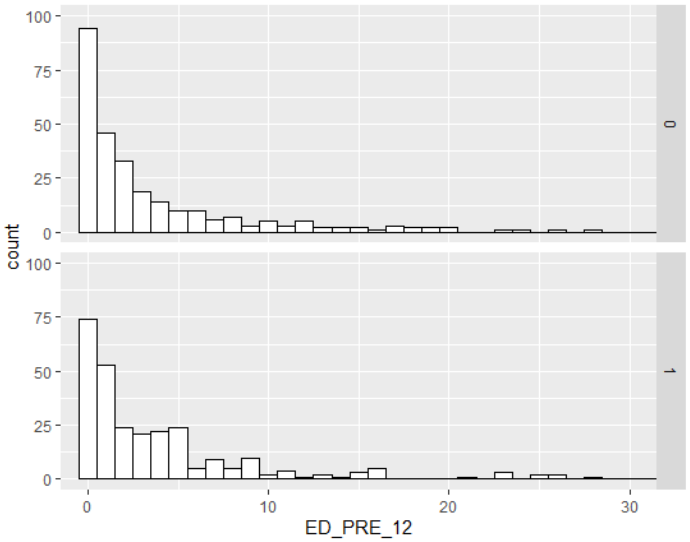
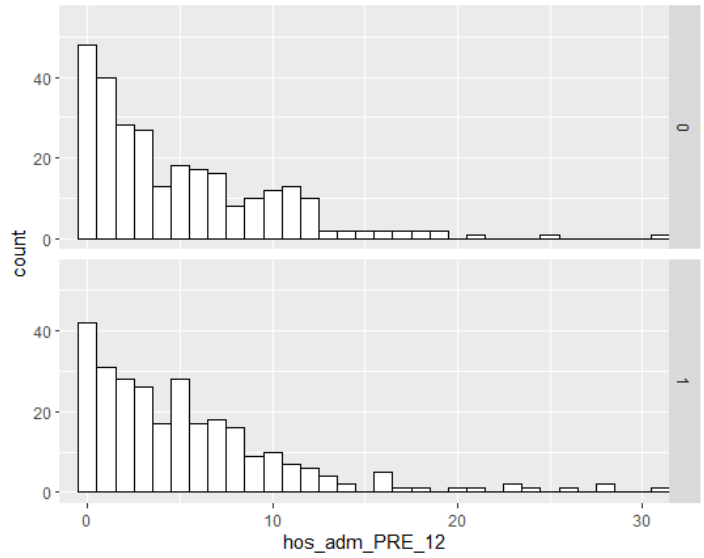


Figure A.2: Histogram: the number of hospital admissions 12 months pre index treatment for IDAT and matched control (1=IDAT, 0=control) (Option 1)



The frequency statistics in the Table A.3 compare the two groups in two pre-treatment outcomes.

Table A.4: Frequency statistics for IDAT and matched control (Option 1)

	Sample size	**Mean**	**Median**	**Min-Max**
Number of hospital admissions 12 months pre index treatment				
IDAT patients	277	5.34	4.0	0.0 - 31.0
Matched control	277	4.95	3.0	0.0 - 31.0
Number of ED visits 12 months pre index treatment				
IDAT patients	277	4.3	2.0	0.0 - 51.0
Matched control	277	3.77	1.0	0.0 - 39.0

Results of option 2:

Figure A.5: Histogram: the number of ED visits 12 months pre index treatment for IDAT and matched control (1=IDAT, 0=control) (Option 2)

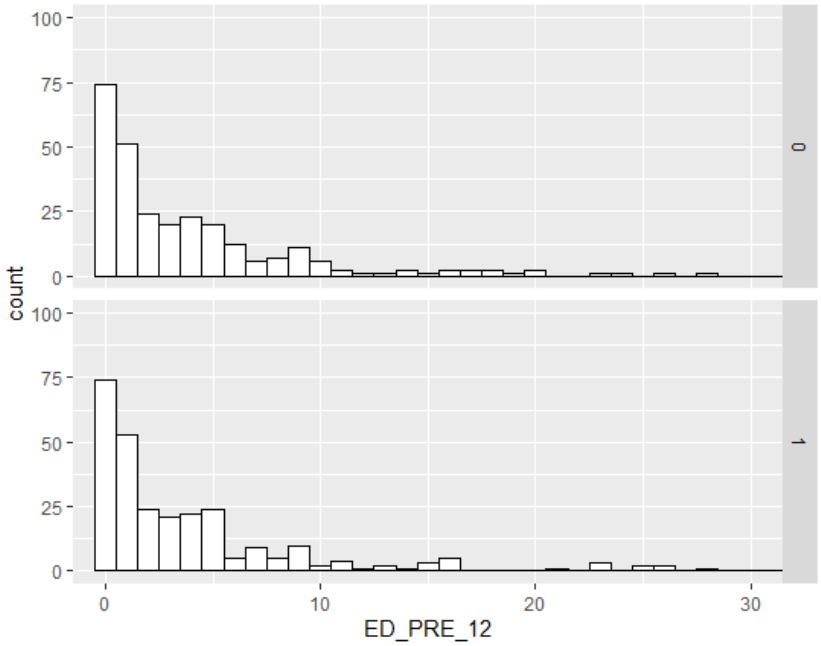
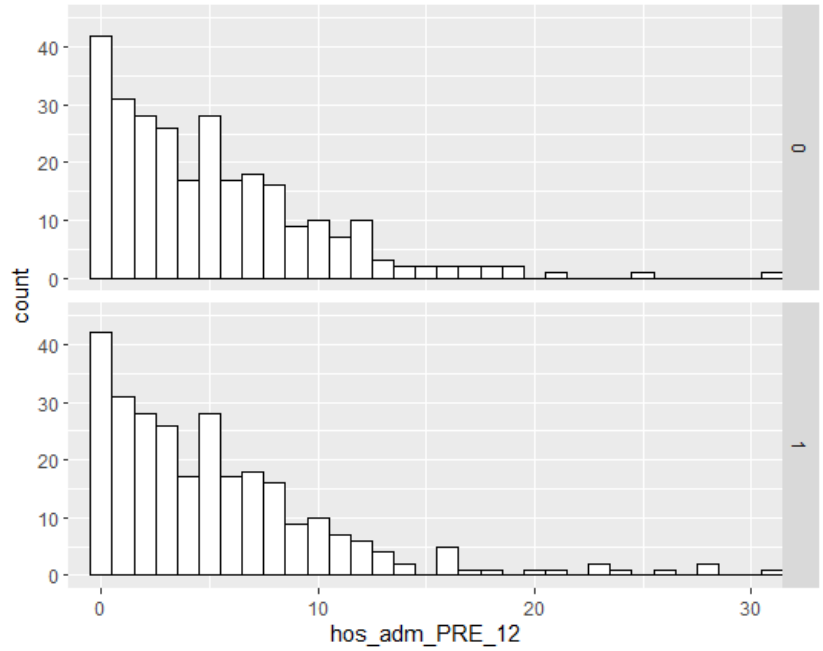


Figure A.6: Histogram: the number of hospital admissions 12 months pre index treatment for IDAT and matched control (1=IDAT, 0=control) (Option 2)



The frequency statistics in the Table A.4 compare the two groups in two pre-treatment outcomes.

Table A.7: Frequency statistics for IDAT and matched control (Option 2)

	Sample size	**Mean**	**Median**	**Min-Max**
Number of hospital admissions 12 months pre index treatment				
IDAT patients	277	5.34	4.0	1.0 - 31.0
Matched control	277	5.13	4.0	1.0 - 31.0
Number of ED visits 12 months pre index treatment				
IDAT patients	277	4.3	2.0	1.0 - 51.0
Matched control	277	4.2	2.0	1.0 - 65.0

Comparing the matching results of Option 1 and Option 2, it shows that when the creation of the n=277 control group included best available matches on demographics, principal drug of concern and hospital and ED admissions (all combined), the result produced minor differences on the two key pre-treatment variables of interest (number of hospital admissions and number of ED presentations). For example, the mean number of ED visits 12 months pre index treatment for IDAT was 5.34 compared to 4.95 in the control group. The median is for IDAT is 4 compared to 3 in the control group. When the creation of the control group was driven only by the pre-treatment variables of interest (hospital admissions and ED presentations) there were identical median (and mean) numbers of pre-treatment ED presentations and hospital admissions between the two groups.

Given that the study aimed to examine the outcomes for IDAT recipients compared to those who would meet eligibility criteria for IDAT (frequent attenders at hospitals, past AOD treatment), Option 2 is a better option because this option yields a closer matched control group. In summary, the control group was created from matching on: 1) the number of ED visits 12 months prior to index treatment; and 2) the number of unplanned hospital admissions 12 months prior to index treatment.

Appendix 7: Data collections and data processing

The table below listed the five data collections, plus the IDAT data provided to the evaluation team by the CHeReL and/or the data custodians.

As with any data linkage study, the process of data cleaning, manipulation, and data merging to create a final data set that was ready for the final data analyses was complex and time-consuming (approximately 80% of the work). The data processing for each data set is briefly described in the second column (number of records and data processing) in the table below.

Table A.8: Data collections and their variables

File name and description	Number of records and data processing
Data collection 1: IDAT (extracted from the NSW MDS DATS by the data custodian) 1. ppn 2. service_start_date 3. service_end_date 4. sex 5. principal_source_of_income 6. living_arrangement 7. type_of_usual_accom 8. patient_type_drug_use 9. principal_drug_gambling 10. principal_use_method 11. injecting_drug_use 12. service_del_setting 13. main_service_provided 14. reason_for_cessation 15. patient_suburb	1. The IDAT data file has 690 records for 277 unique IDAT patients, and 15 variables. 2. Only 478 records have codes of 20, 21, and 70 (for variable Main_service_provided) or have codes of 11E535 and 11N537 (for variable Establishment_identifier, one for Royal North Shore Hospital and the other for Bloomfield Hospital) 3. So we used the data with the 478 records for analysis (of 277 unique IDAT patients). 4. Two sub-files were created: one for all 478 records (multiple records per patients) and one for 277 unique IDAT patients.
Data collection 2: NSW MDS DATS (which include treatment episodes for both IDAT and CONTROL) 1. ppn 2. service_start_date 3. service_end_date 4. sex 5. principal_source_of_income 6. living_arrangement 7. type_of_usual_accom 8. patient_type_drug_use 9. principal_drug_gambling 10. principal_use_method 11. injecting_drug_use 12. service_del_setting 13. main_service_provided 14. reason_for_cessation 15. patient_suburb	1. The total number of records is 79831 (for both IDAT and CONTROL groups): 15 variables 2. After taking out records that belong to the IDAT patients (by using IDAT ppn), we have 75546 records. 3. Next, we only took records that have codes of 21, 22, 31, 32 (old codes) and 20, 30, 48 (new codes) for withdrawal management/detox, Rehab activities, and maintenance pharmacotherapy non-opioid, respectively. We then have 27892 records (of 8935 unique patients). This is the sample for identifying the control group (hereinafter called sample for control group). The control group was identified at a later stage by using propensity score matching method. 4. Two sub-files were created: one for all 27892 records (multiple records per patients) and one for 8935 unique IDAT patients ("pool" sample for the control group).
Data collection 3: NSW APDC (Hospital data) 1. ppn 2. episode_end_date 3. episode_start_date 4. sex 5. age_recode 6. age_grouping_recode 7. ar_drg 8. ar_drg_version 9. MthYr_birth	1. The APDC data set has 122554 records and 43 variables. 2. Using the selected ICD codes to subset records with ICD codes representing alcohol and meth/amphetamine related health problems, we have 69694 records (57% of the original number of records), of which: a. 6056 records belong to IDAT group (by merging using unique IDAT PPNs-Project Person Numbers) b. 57557 records belong to the sample for the control group (by merging using unique PPNs of the "pool" sample for the control group)

10. block_numP 11. diagnosis_codeP 12. diagnosis_code1 13. diagnosis_code2 14. diagnosis_code3 15. diagnosis_code4 16. diagnosis_code5 17. diagnosis_code6 18. diagnosis_code7 19. diagnosis_code8 20. diagnosis_code9 21. diagnosis_code10 22. drg_mode_of_separation 23. emergency_status_recode 24. ed_status 25. episode_leave_days_total 26. episode_length_of_stay 27. episode_of_care_type 28. episode_sequence_number 29. health_insurance_on_admit 30. hours_in_icu 31. hours_on_mech_ventilation 32. involuntary_days_in_psych 33. last_psych_admission_date 34. marital_status 35. MDC (Major Diagnostic Codes) 36. mode_of_separation_recode 37. procedure_codeP 38. procedure_code1 39. procedure_code2 40. procedure_code3 41. procedure_code4 42. source_of_referral_recode 43. srg (service related groups)	3. Because this study only involved "unplanned hospital admissions", only records with are coded as 1=Emergency in the variable "emergency_status_recode" within the APDC were selected, we have 36171 records, of which: a. 3088 records belong to IDAT group (by merging using unique IDAT PPNs) b. 33083 records belong to the sample for the control group (by merging using unique PPNs of the "pool" sample for the control group) *Note: 3101 records neither belong to IDAT nor the sample for the control group*
Data collection 4: NSW EDDC (ED data) 1. ppn 2. triage_date 3. actual_departure_date 4. MthYr_triage_date 5. sex 6. age_recode 7. age_grouping_recode 8. MthYr_birth_date 9. clinical_codeset 10. ed_source_of_referral 11. ed_visit_type 12. marital_status_nhdd 13. mode_of_separation 14. triage_category 15. ed_diagnosis_code 16. ed_diagnosis_code_sct	1. The EDDC data set has 217918 and 16 variables. 2. Using the selected ICD-9, ICD-10, and SNOMED-CT codes to subset records representing alcohol and meth/amphetamine related health problems, we have 36676 records (16.9% of the original number of records), of which: a. 3745 records belong to IDAT group (by merging using unique IDAT PPNs) b. 22953 records belong to the sample for the control group (by merging using unique PPNs of the "pool" sample for the control group) *Note: 9978 records neither belong to IDAT nor the sample for the control group*
Data collection 5: NSW Mental Health Ambulatory Data Collection (MHADC)	The mental health data has 1,048,575 records and 18 variables. The variable "diagnosis_code" was used to create the variable "Complexity score, which was used as a covariate in the final data analyses). See Appendix 2: Method for calculating complexity score for more details.
Data collection 6: NSW Mortality Data	20 IDAT patients (7.3% of 277 patients) were in the mortality data. 14 patients (5.1% of 277 final control patients) were in the mortality data.

The manipulation process to move form the raw data to the outcome data was complex. In the below we provide the details of the steps to create one outcome variable *"number of ED visits"*, which comprised of a variable *"ED_12_PRE: number of ED visits 12 months pre index treatment"* and the variable *"ED_12_POST: number of ED visits 12 months post index treatment"*.

The process of creating the "number of ED visits" involved the following steps:

1. Importing the original EDDC data, which has 217918 records/rows and 16 variables, using the below R codes:
```
EDDC <- read.csv(choose.files("16 IDAT Data Linkage Analysis/EDDC"), na.strings = c("", "NA"), fileEncoding="UTF-8-BOM")
```
2. Using the selected ICD-9, ICD-10, and SNOMED-CT codes to subset records representing alcohol and meth/amphetamine related health problems, we have 36676 records (16.9% of the original number of records), of which:
    a) 3745 records belong to IDAT group (by merging using unique IDAT PPNs)
    b) 22953 records belong to the sample for the control group (by merging using unique PPNs of the "pool" sample for the control group)
```
EDDC_2$ICD_filter <- apply(EDDC_2[c(14:15)], MARGIN=1, FUN = function(x) {
ifelse(any(grepl("F10|F15|F99|F48.9|304|F19|191816009|25702006|15167005|2403008|191480000|66590003|191483003|191802004|361055000|T50.9|305", x)==T), 1,"0")})
```
3. For the IDAT patients (see 2.a above), the number of ED visits per IDAT client before their first IDAT treatment episode needs to be calculated to create the variable *"ED_12_PRE"*. For this, we used two date variables *"actual_departure_date"* of the ED visit and *"service_start_date"* of the first IDAT episode to calculate the difference between two dates in days and put that value into a new variable *"diff_in_days"*.
```
idat_EDDC_final$diff_in_days<-
difftime(idat_EDDC_final$actual_departure_date,idat_EDDC_final$service_start_date , units = c("days"))
```
4. Choose diff_in_days <=0 and >-365 (rows that have ED "actual_departure_date" earlier than IDAT service_start_date, and rows that have records of 12-months pre-IDAT).
```
idat_EDDC_final_PRE_12 <- subset(idat_EDDC_final, diff_in_days <= 0 & diff_in_days > -365)
```
5. Calculate the number of records per unique client, we have variable ED_12_PRE.
```
rows.per.unique_idat_ED_12_PRE  <- aggregate(rep(1, length(paste0(idat_EDDC_final_PRE_12$ppn))),
                                by=list(idat_EDDC_final_12_PRE$ppn), sum)
```
6. The same process was conducted to create the variable ED_12_POST, except that the two variables: "service_end_date" of IDAT and "triage_date" of the ED visit were used to calculate the difference between two dates in days and put that value into a new column "diff_in_days_POST"
7. Merge these two newly created variables back to the original data file for the 277 unique IDAT patients.
8. The same process was conducted for the 277 control patients

Appendix 8: List of mental health diagnosis codes

Table A.9: List of mental health diagnosis codes

Code	Description
F00#	Dementia
F05	Delirium, not induced by alcohol and other psychoactive substances
F06	Other mental disorders due to brain damage and dysfunction and to physical disease
F10	Mental and behavioural disorders due to use of alcohol
F11#	Mental and behavioural disorders due to use of drugs
F20#	Chronic Psychotic Disorder, not elsewhere classified
F20	Schizophrenia
F21	Schizotypal disorder
F23	Acute and transient psychotic disorders
F25	Schizoaffective disorders
F30	Manic episode
F31	Bipolar affective disorder
F32#	Depression
F40	Phobic anxiety disorders
F41	Other anxiety disorders
F42	Obsessive-compulsive disorder
F43	Reaction to severe stress, and adjustment disorders
F44	Dissociative [conversion] disorders
F45	Somatoform disorders
F48	Other neurotic disorders
F50	Eating disorders
F51	Nonorganics sleep disorders
F52	Sexual dysfunction, not caused by organic disorder or disease
F60	Specific personality disorders
F61	Mixed and other personality disorders
F79	Unspecified mental retardation
F80	Specific developmental disorders of speech and language
F81	Specific developmental disorders of scholastic skills
F84	Pervasive developmental disorders
F89	Unspecified disorder of psychological development
F90	Hyperkinetic disorders
F91#	Conduct disorders
F93	Emotional disorders with onset specific to childhood
F98.0	Non-organic enuresis
F98.1	Non-organic encopresis
F99	Mental disorder, not otherwise specified
G40	Epilepsy
R45.81	Suicide ideation
T74.0	Neglect and abandonment
T74.1	Physical abuse
T74.2	Sexual abuse
X84	Intentional self harm by unspecified means
Z60.1	Atypical parenting situation
Z62.0	Inadequate parental supervision and control
Z62.1	Parental overprotection
Z63.8	Other specified problems related to primary support group
Z72.4	Inappropriate diet and eating habits
Z81.1	Family history of alcohol abuse
Z81.8	Family history of mental/behavioural disorder