M.Teesson, J. Ross, S.Darke, M.Lynskey, K.Mills, A.Williamson, K.Hetherington, S.Fairbairn, A.Havard, E.Wilhelm, & M.Shanahan

Twelve month outcomes of the treatment of heroin dependence: Findings from the Australian Treatment Outcome Study (ATOS) New South Wales

NDARC Technical Report No. 191

TWELVE MONTH OUTCOMES FOR THE TREATMENT OF HEROIN DEPENDENCE: FINDINGS FROM THE AUSTRALIAN TREATMENT OUTCOME STUDY (ATOS), NEW SOUTH WALES

Maree Teesson, Joanne Ross, Shane Darke, Michael Lynskey, Katherine Mills, Anna Williamson, Kate Hetherington, Sandra Fairbairn, Alys Havard, Evelyn Wilhelm & Marian Shanahan.

Technical Report Number 191

ISBN: 1 877027 81 2

TABLE OF CONTENTS

LIST OF TABLES

ACKNOWLEDGEMENTS

This project was funded by the National Health and Medical Research Council (National Illicit Drugs Strategy) and the Commonwealth Department of Health and Aging.

The authors would like to thank the treatment agency staff who assisted in the recruitment of participants for ATOS. Special thanks also go to the participants themselves who gave up their time to participate in the study.

EXECUTIVE SUMMARY

INTRODUCTION

Heroin dependence is remarkably persistent and is, in many cases, a lifelong condition, yet the long term outcome following treatment for heroin dependence is rarely studied and has not yet been systematically studied in Australia. Better understanding of the long term outcomes in terms of mortality, drug use patterns, criminality and psychiatric comorbidity has the potential to guide more effective interventions and public health responses both nationally and internationally.

The Australian Treatment Outcome Study (ATOS) is the first large scale longitudinal treatment outcome study of persons with heroin dependence to be conducted in Australia. ATOS is coordinated by the National Drug and Alcohol Research Centre (NDARC), and is conducted in collaboration with the Drug and Alcohol Services Council (DASC) and Turning Point Alcohol and Drug Centre.

The aims of ATOS are:

1. To describe the characteristics of people seeking treatment for problems associated with heroin use in Australia;
2. To describe the treatment received; and
3. To examine treatment outcomes and costs at 3 and 12 months after commencement of treatment.

The current report presents data from the 12 month follow-up interview of subjects in the New South Wales arm of the study.

METHOD

Nineteen treatment agencies were randomly selected from within the three main treatment modalities (methadone/buprenorphine maintenance therapy; detoxification; residential rehabilitation) stratified by area health service. Five hundred and thirty five individuals entering treatment and 80 heroin users not seeking treatment were recruited into the study and interviewed by NDARC staff using a structured questionnaire. A total of 495 individuals were re-interviewed at 12 months, 80% of the original sample. 442 (83%) of the treatment sample and 53 (66%) of the non-treatment sample were successfully recontacted and interviewed at 12 months. A further 31 participants were incarcerated, and 5 deceased at 12 month follow-up. Data was collected on a variety of domains including: treatment experiences; heroin and other drug use, mental health and criminal activity.

RESULTS

- There were no differences between those re-interviewed and those lost to follow up in terms of heroin use at baseline, treatment history or criminal involvement suggesting the sample re-interviewed is broadly representative of the original cohort.

- There were substantial reductions in heroin and other drug use across all three treatment samples. The majority of those who had entered treatment were abstinent from heroin at 12 months (MT 68%, DTX 54%, RR 69%). While there was also an increase in one month abstinence in the non treatment sample, this was considerably less at 25%.

- While current heroin use remained low among the treatment groups, the majority in all groups had used heroin within the 12 months (MT 83%, DTX 92%, RR 74%, NT 100%).

- The reduction in heroin use in the treatment samples was paralleled by reductions in the use of other drugs, suggesting individuals were not substituting heroin use with other drug use to any significant degree.

- There were notable reductions in the percentages of subjects reporting committing any crime or that their major source of income was from crime across the treatment samples.

CONCLUSION

The high rate of sample retention at 12 months is of an international standard and lends validity to the findings. The study attests to the fact that heroin users may be successfully engaged in longitudinal studies. Substantial reductions in drug use, risk-taking, crime and psychopathology among the treatment groups were noted, as were improvements in physical health. Compared to the NT group, participants in the treatment groups had lower levels of drug use, risk-taking and crime. Seventy two per cent of the NT group had enrolled in treatment since baseline, therefore comparisons indicating the benefits of treatment are conservative. Overall, at 12 months the general functioning of the treatment groups had substantially improved since baseline.

1. INTRODUCTION

Over the past 10 years, there have been substantially heightened concerns in Australia about the increased use of heroin and the harms associated with its use. It is estimated that there are over 70,000 Australians dependent on heroin. More people are treated in Australia for opioid dependence than for any other drug class, licit or illicit, yet in 1999 only an estimated 36% of dependent heroin users were in methadone maintenance treatment (Hall et al., 2000).

Given these concerns, Australian Governments are currently giving increased attention both to increasing access to treatment for opiate dependence and to expanding the range of treatment alternatives available. The most commonly used treatment for opiate dependence in Australia is maintenance treatment with approximately 31,000 people currently enrolled in programs in Australia. Other treatment options include outpatient detoxification, inpatient detoxification, short term residential treatment, therapeutic communities, outpatient counselling and other drug free alternatives.

Large scale longitudinal studies examining the effectiveness of treatment services have been conducted successfully overseas. The National Treatment Outcome Research Study (NTORS; Gossop, Marsden & Stewart, 1998), conducted in the United Kingdom, recruited 1,075 clients entering treatment for problems associated with illicit drug use in a number of different agencies. The results of the 12 month follow-up indicated that clients in all treatment modalities had substantially reduced their use of illicit drugs. There were a number of improvements in both physical and mental health, and a substantial reduction in criminal activity. Similar studies have also been conducted in the United States (DATOS; Simpson & Curry, 1997). While these large scale studies provide valuable information, it is debatable whether the effects observed in these studies would translate to an Australian setting. In particular, treatment provision in both the United Kingdom and the United States is markedly different from that provided in Australia. Specifically, the British system of methadone prescription is less tightly regulated than in Australia with methadone and other opiates (including heroin) being prescribed by General Practitioners, with little or no supervision of drug administration. Conversely, the system in the United States is considerably more restrictive with access to methadone being very limited. The system in Australia appears to lie somewhere between these models in terms of both access to treatment and restrictions placed on those in treatment.

The extent to which findings from NTORS and DATOS generalise to the Australian setting is clearly an open question. In order to ascertain the effectiveness of treatment for opiate dependent individuals in an Australian setting, the Australian Treatment Outcome Study (ATOS) commenced in 2001. ATOS is a naturalistic study of treatment outcome in a large cohort of heroin dependent individuals entering treatment, who are interviewed at baseline (treatment entry), 3 months and 12 months. The study also contains data collection components in Victoria and South Australia and collection of data from a comparison group of heroin dependent individuals not seeking treatment.

This report represents the third in a series of reports detailing findings from the New South Wales component of the Australian Treatment Outcome Study. Extensive information on drug use, mental health and related factors were collected at time of treatment entry and at 3 month and 12 month follow-up. We have previously detailed

characteristics of the sample at baseline including patterns of drug use, criminal activity and mental health (Ross et al, 2002). The second report in the series examined short term outcomes at 3 months (Ross et al, 2003). This report details the findings at 12 months. The key findings have also been published in a bulletin (Appendix A).

2. METHODS

2.1 The ATOS (NSW) sample

Baseline data were collected between February 2001 and August 2002 as part of the New South Wales (NSW) component of ATOS. For a more detailed description of sample recruitment and the baseline questionnaire see Ross et al (2002). ATOS is a 12 month longitudinal study of entrants to treatment for heroin dependence, recruited from randomly selected treatment agencies, and a comparison group of non-treatment heroin users. Subjects were recruited from 19 agencies treating heroin dependence in the greater Sydney region, randomly selected from within treatment modality and stratified by regional health area. The agencies comprised ten methadone/ buprenorphine maintenance (MT) agencies, four drug free residential rehabilitation agencies (RR) and nine detoxification facilities (DTX). Four agencies provided both maintenance and detoxification services. In addition, a comparison group of heroin users not currently in treatment (NT) were recruited from needle and syringe exchange programs in the regional health areas from which treatment entrants were recruited.

Eligibility criteria were: i) no treatment for heroin dependence in the preceding month, ii) no imprisonment in the preceding month, iii) agreed to give contact details for follow-up interviews, iv.) had a good understanding of English, and v) were 18 years or older. Thus, no participant had been in treatment for the month prior to interview, the period over which health service utilisation was measured. A total of 1530 clients entering treatment were approached to participate in ATOS, of whom 694 were eligible for inclusion in the study (the majority (82%) of those not meeting eligibility criteria reported having been in treatment and/or prison within the preceding month). Five hundred and thirty five of those eligible were enrolled in the study.

The NT group consisted of 80 heroin using individuals not currently in any form of treatment. These individuals were selected after 434 individuals were screened for eligibility. Of these 434 clients of needle and syringe exchange programs who were approached, 213 (49%) did not meet eligibility criteria, with the principal reason for exclusion being that they had been in some form of treatment for heroin dependence within the preceding month (82% of those deemed ineligible). The participation rate among those eligible for the study was therefore 36%.

The total sample was thus 615 heroin users. All subjects were paid A$20 for completing the baseline interview, which took approximately 1 hour to complete. A brief description of the baseline interview is provided below. The conduct of this study was independently reviewed and approved by the ethics committees of the University of New South Wales and each of the Area Health Services responsible for the clinics included in the study.

Subjects were interviewed at baseline, 3 months and 12 months. The Outcomes at 12 months are presented in this report.

2.2 Baseline interview

Subjects were administered a structured interview (see Ross et al, 2002 for details). Sections addressed demographic characteristics, treatment history**,** drug use history, heroin overdose history, injection-related risk-taking behaviour, injection-related health, general health, criminal activity, current Major Depression, Post Traumatic Stress Disorder, Anti-Social Personality Disorder, Borderline Personality Disorder.

In addition, locator information was collected at baseline to facilitate follow-up. The following information was collected: full legal name, nicknames/street names, other surnames that had been used, height, distinguishing physical features, current address, name of person whose address this was, participant's phone number/s, where they expect to be living in 12 months time, name of a doctor or community health centre that would know how to reach the participant, the first person they would contact if arrested, where they would go if they could no longer stay at their current address, places where they spend time, where messages could be left for them, and the contact details of at least two friends, relatives or associates who could be contacted if needed to assist in locating the participant for follow-up.

2.3 Structured interview at 12 month follow-up

Twelve months after the baseline interview extensive efforts were made to recontact and re-interview all individuals who had participated in the baseline interview. If respondents were no longer at the same address as when they were enrolled in the study or interviewed at three or 12 months extensive locator information, including the names and addresses of at least three contact persons such as parents, siblings or best friends (see section above) was available. Multiple efforts were made to contact these persons. Once contacted, the purpose of the ongoing study was (re) explained to study participants and they were invited to participate in the follow-up interview at a time and location of their convenience. Participants received A$20 to recompense them for costs associated with participating in the interview.

The 12 month interview was an abbreviated form of the baseline interview and included questioning on the following topics:

2.3.1 Treatment history

Participants were asked how many times they had commenced the various treatment options for heroin dependence, how recently they had attended each type of treatment and the duration of that treatment episode.

2.3.2 Drug use history

Drug use in the preceding month was assessed using the Opiate Treatment Index (OTI; Darke et al, 1992).

2.3.3 Heroin overdose history

Questions regarding lifetime history of non-fatal heroin overdose were based on earlier work conducted by the authors (Darke et al, 1996).

2.3.4 Injection-related risk-taking behaviour

The injecting sub-scale of the HIV Risk-Taking Behaviour Scale (HRBS), a component of the OTI, was used to measure current injection related risk behaviour (Darke et al, 1992).

2.3.5 Injection-related health

The injection-related sub-scale of the OTI health scale was used to assess injection-related health problems (Darke et al, 1992).

2.3.6 General health

The Short Form-12 (SF-12) is a standardised, internationally used instrument that provides a general measure of health status (Ware et al, 1996). The 12 items on the SF-12 are summarised in two weighted summary scales, and generate a mental health and a physical health score. The SF12 is standardised with a mean score of 50 and a standard deviation of 10. Lower scores are indicative of more severe disability.

2.3.7 Criminal activity

Using the criminality scale of the OTI (Darke et al, 1992), participants were asked how frequently they had committed any property crime, dealing, fraud and/or violent crime in the preceding month.

2.3.8 Current Major Depression

Past month diagnoses of DSM-IV Major Depression were assessed using the version of the Composite International Diagnostic Interview (CIDI) used in the National Survey of Mental Health and Wellbeing (NSMHWB; Andrews et al, 1999).

2.3.9 Locator information

To facilitate future follow-up, the locator information was checked for accuracy and, where appropriate, updated.

2.4 Statistical analyses

Where data were highly skewed medians were reported. Means were reported for non-skewed data. In order to determine factors independently associated with dichotomous variables, logistic regressions were conducted. Independent predictors of continuous variables were determined using linear regression. All analyses were conducted using SPSS for Windows, version 11.0 (SPSS Inc, 2001).

3. RESULTS

3.1 Sample characteristics

At baseline, the mean age of the 615 particiapants was 29.2 yrs (SD 7.8, range 18-56), and 65% were male**.** The sample had completed a mean of 10.1 yrs of secondary education (SD 1.6, range 2-12), 31% had completed a trade/technical course, and 6% a university degree. Thirty seven percent had a prison history. The main sources of income were: social security allowances (45%), criminal activity (23%), wage/salary (19%).

The mean age of first intoxication was 13.7 yrs (SD 3.3, range 2-34), and 19.6 yrs (SD 5.2, range 9-43) for first heroin use. The mean length of heroin use career at baseline was 9.7 yrs (SD 7.6, range <1-35yrs). The mean OTI heroin use score was 2.3 (SD 2.4, range 0.04-33.3). The sample had used a mean of 9.1 (SD 1.7, range 2-11) drug classes in their lives, and 4.8 (SD 1.7, range 2-9) in the month preceding interview. Ninety percent had been enrolled in treatment for opiate dependence prior to ATOS, with no differences between index groups. Twenty six percent met criteria for current Major Depression, and 42% for a lifetime diagnosis of PTSD. A diagnosis of BPD was received by 45% of the sample, and ASPD by 70%.

3.2 The ATOS sample at 12 months

A total of 495 individuals were re-interviewed at 12 month follow-up, representing 80% of the sample enrolled in the study at baseline. A further 31 participants were incarcerated, and 5 deceased. Follow-up rates for the four groups were: 83% (MT), 85% (DTX), 78% (RR), 66% (NT). The mean length of follow-up was 369.2 days (SD 56.3, range 310-722). Only 7% were reinterviewed more than 90 days after 12 month follow-up due date.

In order to determine factors associated with retention in the cohort at 12 months, a logistic regression was conducted. Variables entered into the model included index group, age, sex, previous treatment history, number of heroin use days in the month preceding baseline interview, suicide history, Major Depression at baseline, PTSD and presence/absence of a personality disorder. The overall model was significant (χ^2=22.8, df=11, p<.05). Participants in the treatment groups were more likely to be retained than those in the NT group (82% v 66%, OR 2.42, 95% CI: 1.45-4.05). No other factors were significantly associated with sample retention.

Those re-interviewed and those lost to follow-up did not differ significantly from each other in terms of age, gender, treatment history, number of heroin use days in the month before baseline, Major Depression, PTSD, and personality disorders. Overall, this pattern of results suggests that the sample re-interviewed at 12 month follow-up was broadly representative of the initial sample of 615 enrolled in ATOS.

3.3 Treatment retention

Table 1 shows retention in the index treatment at 12 months and the percentage of each group (including NT) who were in any treatment at 12 month follow-up. Detoxification programs are generally no longer than 7 to 10 days duration, and RR less than one year, thus only individuals receiving MT were retained in the index treatment at 12 months. The retention in the MT group was 43%.

Table 1 also shows whether subjects were in any form of treatment (not just their index treatment) at 12 months. A large number of MT (81%) and RR (45%) clients were in some form of treatment at 12 months, with the most popular treatment modality among the latter group being residential rehabilitation. Similarly, just over half (50%) of those who had entered detoxification were receiving some form of treatment at the time of the 12 month follow-up. Just under half (45%) of the non-treatment group were also in some form of treatment at 12 month follow-up, with the most common form of treatment being MT.

The median cumulative treatment days over the follow-up period for the whole sample was 149 (range 0-590): MT 331 days, DTX 73.8 days, RR 132.5 days, and NT 30 days (Table 1). The NT group spent significantly less days in treatment than those entering the study through treatment over the follow-up period (30 v 162 days, Mann Whitney U = 5805.0, p<.001).

Table 1: Treatment involvement at 12 months by treatment modality at baseline

	MT (N=167)	DTX (N=171)	RR (N=104)	NT (N=53)	TOTAL (N=495)
Still in index treatment (%)	43	0	0	N/A	16 *
Currently in treatment, but not the index treatment (%)	38	50	45	45	45
Current treatment - includes ongoing index treatment (%):					
None	19	49	55	55	41
Methadone maintenance	67	22	5	30	31
Outpatient detoxification	1	2	0	0	1
Inpatient detoxification	0	3	2	2	2
Residential rehabilitation	1	6	19	0	7
Buprenorphine maintenance	11	10	6	9	9
Outpatient counselling	0	8	14	4	6
Naltrexone maintenance	1	1	0	0	1
Other	0	1	0	0	0
Median cumulative treatment days since baseline interview	331	73.8	132.5	30	149

* N=442, excludes NT group

3.4 Treatment experiences during the 12 months

While Table 1 shows the percentage of people in each index group who were in some form of treatment at 12 months, it is also the case that a number of people received additional treatment in the intervening 12 months. Details of all treatment experiences since the index treatment are summarized in Table 2. The majority (89%) of those who entered detoxification at baseline experienced some additional form of treatment in the intervening 12 months, as did 68% of those entering residential rehabilitation and 49% of those entering MT. Seventy two per cent of those in the non-treatment group also entered some form of treatment in the 12 months between baseline and follow-up interviews.

Table 2: Treatment history between baseline and 12 month follow-up by treatment modality

	MT (N=167)	DTX (N=171)	RR (N=104)	NT (N=53)	TOTAL (N=495)
Any intervention since baseline interview (excludes index treatment) (%)	49	89	68	72	69
Mean treatment episodes since baseline interview (excludes index treatment)	1.3	3.1	2.4	2.0	2.3

Note: *interventions include: MT, Outpatient detoxification, Inpatient detoxification, Residential rehabilitation, Rapid opiate detoxification using naltrexone, Other maintenance therapy eg. buprenorphine, LAAM, Outpatient counselling, Naltrexone maintenance.*

3.5 Changes in heroin use from baseline to 12 months

There were dramatic changes in past month heroin use between baseline and 12 months (Table 3). Heroin abstinence rates climbed dramatically in all three treatment modalities: from 3% to 68% in the MT group, from 0% to 54% in DTX and from 2% to 69% in RR. There were substantial reductions in the number of days heroin was used in the last month in all three treatment groups (Table 3). Heroin had been used on a mean of 2.6 days by the MT group, 5.5 days by the DTX group and 3.4 days by the RR group. There was a smaller decline amongst the NT group, who had used on a mean of 10.3 days. None of these subjects reported abstinence in the past month at baseline (a function of the NT inclusion/ exclusion criteria in the study), while 25% reported past month abstinence at 12 month follow-up.

Changes in the rates of abstinence from heroin were paralleled by a reduction in the median heroin OTI score. The MT group reduced from a median of 1.5 at baseline to a median of 0 at 12 month follow-up, the DTX group reduced from a median of 2 at baseline to 0 at 12 months and the RR group reduced from a median of 1.5 to 0 at 12 months. There was evidence of a less marked reduction among the NT group, from 2.0 at baseline to 0.3 at 12 month follow-up.

While current heroin use remained low among treatment groups, the majority in all groups had used heroin within the 12 months: MT (83%), DTX (92%), RR (74%) & NT (100%). Overall, 14% of participants (all of whom entered treatment) were abstinent for the entire 12 months.

In order to examine the factors associated with the number of heroin use days at 12 months, a linear regression was conducted controlling for age, gender, index treatment status and baseline heroin use. The model was significant ($F_{4,489}$=9.6, p<.001). While age and gender were not significant, having been in a treatment modality at baseline was independently associated with fewer heroin use days at 12 month follow-up (3.9 v 10.3,

β=-0.2, t=-5.2, p<.001). A greater number of baseline heroin use days was also independently associated with more frequent heroin use at 12 months (β=0.1, t=2.8, p<.005).

A logistic regression was also conducted examining the effect of baseline treatment status on abstinence rates at 12 months, controlling for age, gender and abstinence at baseline (χ^2=30.7, df=4, p<.001). Baseline treatment status was the only significant factor, with the treatment modalities having higher rates of abstinence at 12 months than the non-treatment group (63% v 25%, OR 5.17, 95% CI: 2.68-9.94).

3.6 Changes in other drug use from baseline to 12 months

As shown in Table 3, there were notable reductions in the use of other drugs among all treatment modalities. These changes appeared most evident in the RR treatment group: the use of other opioids by this group declined from 23% at baseline to 5% at follow-up, use of amphetamines fell from 37% to 18%, use of cocaine fell from 35% to 3%; use of benzodiazepines fell from 49% to 14% and use of cannabis fell from 72% to 32%. Among the treatment modalities, the drug classes where there appeared to be little or no changes in levels of use between baseline and 12 months included alcohol and tobacco. While the non-treatment group also showed some reduction in other drug use, this reduction was less marked. In examining the number of drug classes used at 12 months (including heroin), a linear regression was conducted controlling for age, gender, index treatment status and the number of drugs used at baseline. The model was significant ($F_{4,490}$=19.3, p<.001). Participants who had entered treatment at baseline had used significantly fewer drug classes at 12 months than the non-treatment group (3.0 v 4.4, β=-1.2, t=-5.1, p<.001). A higher level of baseline drug use was also independently associated with using a greater number of drug classes at 12 months (β=0.3, t=6.4, p<.001). There was no effect of age or gender.

Table 3: Comparison of drug use at baseline and 12 months by treatment modality

	MT (N=167)		DTX (N=171)		RR (N=104)		NT (N=53)	
	BL	12 mths	BL	12 mths	BL	12 mths	BL	12 mths
Median Heroin OTI score	1.5	0	2.0	0	1.5	0	2.0	0.3
Mean number of heroin use days in last month	19.0	2.6	23.4	5.5	17.1	3.4	21.8	10.3
Abstinent from heroin in preceding month (%)	3	68	0	54	2	69	0	25
Drugs used in last month (%):								
Heroin	97	32	100	46	98	31	100	76
Other opiates	35	7	28	12	23	5	36	23
Amphetamines	26	17	22	12	37	18	43	26
Cocaine	31	8	43	8	35	3	66	36
Hallucinogens	3	5	9	6	16	6	19	9
Benzodiazepines	47	26	47	23	49	14	42	40
Antidepressants	16	16	11	13	19	16	4	11
Alcohol	41	49	53	51	60	43	62	55
Cannabis	70	59	62	43	72	32	70	64
Inhalants	1	0	1	1	2	0	4	0
Tobacco	95	92	92	90	97	92	100	96
Mean no. of drug classes used last month	4.6	3.1	4.7	3.0	5.1	2.6	5.5	4.4

3.7 Heroin overdose

There were notable reductions in rates of non-fatal heroin overdose among treatment modalities (Table 4) with the lowest rate of overdose observed in those in the MT group. In order to examine overdose experience between the baseline and 12 month interview, a logistic regression was conducted (χ^2=50.4, df=4, p<.001), controlling for age, gender, overdose experience in the 12 months preceding baseline interview, and index treatment status. Those participants who had overdosed prior to baseline were more likely than the remainder of the sample to have overdosed during the intervening months between baseline and 12 month follow-up (OR 7.33, 95% CI: 4.11-13.07). Gender was also independently associated with a greater likelihood of having overdosed during the 12 month follow-up period, with males being more likely to have overdosed than females (OR 1.99, 95% CI: 1.04-3.80). There was no significant effect of age or baseline treatment status.

Table 4: Prevalence of heroin overdose

	MT (N=167)		**DTX (N=171)**		**RR (N=104)**		**NT (N=53)**	
	BL	12 mths	BL	12 mths	BL	12 mths	BL	12 mths
OD past 12 months (%)	22	4	21	15	33	19	21	15
OD past month (%)	6	1	11	2	14	3	4	8

3.8 General physical health

3.8.1 Physical health as assessed by the SF-12

The mean SF-12 physical health scores improved across all treatment modalities at 12 months and were closer to the general population norm than they were at baseline (Table 5). A linear regression examining physical health scores at 12 month follow-up was conducted controlling for age, gender, index treatment status and baseline SF-12 physical health score. The model was significant ($F_{4,488}$=14.5, p<.001). Higher baseline SF-12 scores (β=0.3, t=6.6, p<.001) were independently associated with higher physical SF-12 score (better health) at 12 month follow-up. Younger age was also independently associated with having a higher SF-12 score (β=-0.1, t=-2.2, p<.05).

Factors associated with having injection-related health problems in the month preceding the 12 month interview were examined using a logistic regression (χ^2=43.0, df=4, p<.001). The variables entered into the model were age, gender, index treatment status and presence/absence of injection-related health problems at baseline. Not entering treatment at baseline (OR 5.04, 95% CI: 2.75-9.26), and having injection-related health problems at baseline (OR 2.80, 95% CI: 1.58-4.97), were independently associated with injection-related health problems at 12 months.

Table 5: Physical health

	MT (N=167)		DTX (N=171)		RR (N=104)		NT (N=53)	
	BL	12 mths	BL	12 mths	BL	12 mths	BL	12 mths
SF-12 Physical health component score (mean)	43.4	48.6	43.4	49.8	44.0	50.9	43.6	46.9
Injection-related health problems	70	19	73	24	86	26	76	59

3.9 Risk Taking

All treatment groups showed marked declines in the proportions injecting at least daily (Table 6). Seven per cent of the MT group were injecting at least daily at 12 months. Sixteen per cent of the DTX group were doing so, down from 81%. A smaller decline was noted in the NT group, where 36% were still injecting at least daily at follow-up. There were similar patterns of decline in the borrowing and lending of used needles among the treatment groups (Table 6).

Table 6: Needle risk-taking behaviours at baseline and 12 months

	MT (N=167)		DTX (N=171)		RR (N=104)		NT (N=53)	
Behaviours/ problems in preceding month	BL %	12mth %	BL %	12mth %	BL %	12mth %	BL %	12mth %
Injecting at least daily	74	7	81	16	78	12	83	36
Borrowed needle	13	5	16	5	28	6	21	9
Lent needle	28	4	25	5	33	5	28	19

3.10 Mental health

3.10.1 General mental health

All treatment groups showed differences in self reported mental health between baseline and 12 month follow-up (Table 7). A linear regression examining SF-12 mental health scores at 12 month follow-up was conducted ($F_{4,488}$=15.6, p<.001), controlling for age, gender, index treatment status and baseline SF-12 mental health score. Higher baseline SF-12 scores (β=0.4, t=7.2, p<.001), entering treatment at baseline (β=3.8, t=2.2, p<.05) and younger age (β=-0.2, t=-2.7, p<.01) were independently associated with higher mental SF-12 score (better mental health) at follow-up.

3.10.2 Major Depression

Rates of current Major Depression dropped from 23% to 7% among those entering maintenance treatment, from 26% to 14% among those entering detoxification and from 35% to 10% among those entering residential rehabilitation. In contrast, rates of current Major Depression remained relatively stable in the non-treatment group (13% at baseline and 15% at 12 months). A similar pattern of results emerged for past month suicidal ideation and attempted suicide: rates of these behaviours fell dramatically in each of the three treatment groups, but remained relatively stable in the non-treatment group.

Using logistic regression, current Major Depression status at 12 months was examined controlling for age, gender, index treatment status and baseline depression status (χ^2=25.0, df=4, p<.001). Meeting DSM-IV criteria for Major Depression at baseline was the only factor significantly associated with Major Depression status at 12 month follow-up (OR 3.83, 95% CI: 2.11-6.94).

Table 7: Mental health at baseline and 12 months by treatment modality

	MT (N=167)		DTX (N=171)		RR (N=104)		NT (N=53)	
	BL	12 mth	BL	12 mth	BL	12 mth	BL	12 mth
SF-12 Mental health component score (mean)	32.7	44.6	30.8	40.3	28.2	40.5	37.7	40.3
Current Major Depression (%)	23	7	26	14	35	10	13	15
Thought a lot about committing suicide (%)	21	5	24	8	32	6	9	13
Made a suicide plan in past month (%)	13	3	17	4	17	5	6	6
Attempted suicide in preceding month (%)	3	1	6	1	6	0	2	4

3.11 Criminal activity and other sources of income

In parallel with the reductions in drug use and improvements in mental health, there were marked reductions between baseline and 12 month follow-up in the percentages of respondents who reported having committed crime in the one month preceding interview (Table 8). Specifically, self-reported involvement in any criminal activity in the past month fell from 47% to 19% among people in MT, from 59% to 25% among those who had entered detoxification and from 56% to 25% among those entering residential rehabilitation. In comparison, there was a less marked drop in crime among the non-treatment group, from 60% to 40%. Property crime (16%) and dealing (10%) remained the most common forms of crime reported at 12 months.

A logistic regression examining factors associated with criminal activity at 12 months was conducted. Variables entered into the model were age, sex, index treatment status and criminal activity at baseline. The model was significant (χ^2=42.1, df=4, p<.001).
Those participants who had a history of criminal activity were more likely to be committing crime at 12 months (OR 3.50, 95% CI: 2.17-5.64) and those who were not in treatment at baseline were more likely to be committing crime at 12 months (OR 2.30, 95% CI: 1.23-4.31). There was no significant effect of age or gender.

Table 8: Criminal activity at baseline and 12 months by treatment modality

	MT (N=167)		**DTX (N=171)**		**RR (N=104)**		**NT (N=53)**	
	BL	12 mth	BL	12 mth	BL	12 mth	BL	12 mth
Any crime in preceding mth (%)	47	19	59	25	56	25	60	40
Type of crime committed (%):								
Property	31	14	40	17	44	12	42	25
Dealing	20	6	25	11	23	11	40	23
Fraud	10	2	15	5	24	7	21	15
Violent	4	2	12	2	8	0	2	2

Reductions in self-reported criminal activity were paralleled by reductions in the percentages of respondents who reported criminal activity as their major source of income. Specifically, the percentage of people reporting criminal activity fell from 17% to 2% among those entering MT, from 24% to 4% among those entering detoxification and from 26% to 2% among those entering residential rehabilitation. In contrast, the reduction in the percentage of people in the non-treatment group who reported criminal activity as their primary income source was less marked: from 32% to 17%.

3.12 Summary of changes in drug use, crime and mental health from baseline to 12 months

In order to examine change over time in the major domains of drug use, crime, physical and mental health, a series of linear and logistic regressions were conducted using measures obtained at 12 months as the dependent variables (Table 9). Age, gender,

treatment status at baseline and a baseline measure of the dependent variable were entered into all regression models. With the exclusion of current Major Depression and physical heath and crime, participants who had entered treatment at baseline showed significantly greater improvement in all areas than the non-treatment group. Controlling for baseline functioning, at 12 months the treatment group had fewer heroin use days in the preceding month, were more likely to be abstinent, had used fewer drug classes, had better injection-related health and better general mental health than the non-treatment group. Poorer baseline functioning in terms of the number of heroin use days, polydrug use, injection-related health problems, general physical and mental health and current Major Depression were also independently associated with poorer functioning in each of these areas at 12 months.

Table 9: Comparison of drug use, crime, physical and mental health at baseline and 12 months for the treatment and non treatment groups

	Treatment (N=442)		NT (N=53)		Comparisons
	BL	12 mth	BL	12 mth	
Drug Use					
Mean number of heroin use days	20.2	3.9	21.8	10.3	$F_{4,489}$=9.6, p<.001 (More heroin use days at baseline: β=0.1, t=2.8, p<.005; Non-treatment group: β=-0.2, t=-5.2, p<.001)
Abstinent from heroin in preceding month (%)	2	63	0	25	χ^2=30.7, df=4, p<.001 (Treatment group: OR 5.17, 95% CI: 2.68-9.94)
Mean no. of drug classes used last month	4.8	3.0	5.5	4.4	$F_{4,490}$=19.3, p<.001 (Greater number of drugs used at baseline: β=0.3, t=6.4, p<.001; Treatment group: β=-1.2, t=-5.1, p<.001)
Physical Health					
SF-12 Physical health component score (mean)	43.6	49.6	43.6	46.9	$F_{4,488}$=14.5, p<.001 (Higher baseline SF-12 score: β=0.3, t=6.6, p<.001; Younger age: β=-0.1, t=-2.2, p<.05)
Injection-related health problems in preceding month (%)	75	22	76	59	χ^2=43.0, df=4, p<.001 (Injection-related health problems at baseline: OR 2.80, 95% CI: 1.58-4.97; Non-treatment group: OR 5.04, 95% CI: 2.75-9.26)
Mental Health					
SF-12 Mental health component score (mean)	30.9	42.0	37.7	40.3	$F_{4,488}$=15.6, p<.001 (Higher baseline SF-12 score: β=0.4, t=7.2, p<.001; Treatment group: β=3.8, t=2.2, p<.05; Age β=-0.2, t=-2.7, p<.01)
Current Major Depression (%)	27	10	13	15	χ^2=25.0, df=4, p<.001 (Current Major Depression at baseline: OR 3.83, 95% CI: 2.11-6.94)
Crime					
Committed crime in the preceding month	53	22	60	40	χ^2=42.1, df=4, p<.001 (Baseline criminal activity: OR 3.50, 95% CI: 2.17-5.64; Non-treatment group: OR 2.30, 95% CI: 1.23-4.31)

4. Discussion

4.1 Major findings

The first major finding of this study concerned the feasibility of conducting longitudinal research within this population. The follow-up rate of 80% indicates that such research is eminently feasible. In addition to the 495 subjects interviewed a further 31 participants were incarcerated, and 5 deceased.

In terms of outcome, the major finding were that there were:

- substantial reductions in heroin use across all three treatment modalities
- substantial reductions in injection frequency, needle risk behaviours and heroin overdose.
- declines in injection-related problems, and improvements in general health among all treatment groups
- large declines in reported crime amongst all treatment groups and
- large improvements in general mental health.

4.2 Sample retention

At 12 month follow-up 80% of those entering the ATOS study were successfully re-contacted and re-interviewed. This response rate exceeds those of other longitudinal studies of treatment seeking drug use populations conducted overseas (Gerstein et al, 1994; Simpson & Sells, 1990; Hubbard et al, 1989; Hubbard et al, 1997; Gossop et al, 1997), and indicates that, despite the often chaotic lifestyle of people with opioid dependence, it remains feasible to conduct longitudinal studies of treatment outcomes in this group. Importantly, there appeared to be little difference between individuals re-interviewed at 12 months and those lost to follow-up, assessed on baseline characteristics. Most importantly, these two groups did not differ on levels of heroin use at baseline.

4.3 Treatment retention and other treatment experiences

A strength of the ATOS study design was that comprehensive information on treatment experiences between baseline and follow-up was obtained. Analysis of this data indicated that in the MT group rates of treatment retention were relatively high, with 43% of people remaining in their index treatment at 12 month follow-up. As expected in the DTX group and RR group, no individuals had remained in a single treatment episode for 12 months. Nonetheless, many of the individuals in these groups subsequently received some form of treatment: 49% of those entering MT, 89% of those entering DTX and 68% of those entering RR. Importantly, 72% of those in the non-treatment group also accessed some form of treatment for heroin dependence in the 12 months between study entry and follow-up interview. However, the NT group had spent significantly fewer days in treatment for there heroin dependence over the follow-up period compared with those who were in treatment at baseline (median 26 v 126 days). Access to treatment in this group may potentially explain some of the observed improvements in drug use and other outcomes and suggests that comparisons between treatment and non-treatment groups in this study may provide only a conservative estimate of the potential benefits of treatment for heroin dependence.

4.4 Heroin and other drug use

A pivotal finding to emerge from this study was that 12 months after entering treatment there had been a dramatic decline in levels of heroin use among those entering treatment. The vast majority of those entering treatment reported reducing their heroin use at 12 months. Between 54% and 69% of those in treatment at the baseline interview reported that they were abstinent from heroin at 12 months.

In addition, there was no evidence to suggest a process of substitution whereby reduced heroin use was countered by an increase in the use of other drugs such as benzodiazepines. Indeed, it appeared that, overall, the use of other drugs also declined in the treatment group between baseline and 12 month interviews. In addition to the reductions in drug use among the treatment samples, there were also substantial reductions in injection frequency, and needle risk behaviours.

The Australian Treatment Outcome Study relies on self report of drug use. Hair sampling was conducted at 3 months as a bio-marker for heroin use over the month preceding interview. The full details of the method are presented in the 3 month report of the study (Ross et al, 2003). In brief, eleven percent (n=61) of the participants followed up at 3 months were randomly selected and asked to provide a hair sample.

There were significant correlations between OTI heroin use scores and hair morphine concentrations (rs=0.53), and between number of reported heroin use days in the preceding month and hair morphine concentrations (rs=0.52). The overall agreement between any self-reported heroin use in the preceding month and the presence of morphine in hair was 75% (kappa=0.51). In 15% of cases heroin use was reported by participants, but morphine was not detected in their hair. In 6 of these 9 cases, self-reported heroin use was on 4 or fewer days over the preceding month. Thus, in only 10% of cases was heroin use in the preceding month denied, but morphine detected in hair samples.

The high rates of concordance between self report and the bio-marker are consistent with those reported in other studies of self-reported drug use among heroin users (Darke, 1998; Darke et al, 2002). In particular, the fact that the majority of disagreement between self-report and hair analysis was due to self-reported drug use not being detected by biomarkers is consistent with the broader literature on the validity of self-reported drug use (Darke, 1998).

4.5 Mental health

Ratings of general mental health improved in the treatment groups, but remained relatively unchanged in the non-treatment group A similar trend towards improvement was seen in relation to current Major Depression. However, baseline treatment status was not found to be significantly associated with having a major depressive disorder at 12 month follow-up. The rates of comorbid depression are a concern in this group and future ATOS studies will examine the impact on both treatment entry and treatment outcome.

4.6 Physical health

General physical health improved significantly across all treatment modalities. In contrast, 12 months after entering treatment there had been a significant decline in

injection related health problems among those entering treatment. Only 22% of participants entering treatment reported injection related health problems at 12 months compared to 75% at baseline. This finding may possibly reflect the greater treatment exposure of those entering treatment compared to the NT group.

4.7 Criminal activity

Again, there were substantial reductions in self-reported criminal activity for the treatment groups between baseline and 12 month interviews. Such findings parallel the existing literature showing that successful engagement with treatment services is accompanied by substantial reductions in criminal activity (Hubbard et al, 1997). Such reductions can be considered as a major benefit of treatment and are typically attributed to a reduction in drug use.

4.8 Summary and conclusions

The majority of ATOS participants, in both the treatment and non-treatment modalities, were successfully located and re-interviewed at 12 months. Retention in the index treatment was highest among the MT group, but across all modalities (including the non-treatment sample) use of other treatment services was common. At 3 months, substantial reductions in drug use, risk-taking, crime and psychopathology among the treatment groups were noted, as were improvements in physical health (Ross et al, 2003). The current data indicate that these improvements were maintained at 12 months. Compared to the NT group, participants in the treatment groups had lower levels of drug use, risk-taking and crime. General psychological distress also improved and injection related health problems reduced. With 72% of the NT group having enrolled in treatment since baseline, comparisons indicating the benefits of treatment are conservative, although the NT group spent a median of only 30 days in treatment compared to 162 in the treatment groups. Overall, at 12 months the general functioning of the treatment groups had substantially improved since baseline. ATOS demonstrates that the provision of treatment substantially improves the health and welfare of heroin users.

5. REFERENCES

Andrews, G., Hall, .W, Teesson, M., Henderson, S. (1999). *The mental health of Australians: National Survey of Mental Health and Wellbeing*. Canberra: Commonwealth Department of Health and Aged Care.

Darke, S. (1998). Self-report among injecting drug users: a review. *Drug and Alcohol Dependence* 51, 253-263.

Darke, S., Hall W., Wodak, A., Heather, N., Ward, J. (1992). Development and validation of a multi-dimensional instrument for assessing outcome of treatment among opiate users: The Opiate Treatment Index. *British Journal of Addiction* 87, 733-742.

Darke, S., Ross, J., Hall, W. (1996). Overdose among heroin users in Sydney, Australia: I. Prevalence and correlates of non-fatal overdose. *Addiction* 91, 405-411.

Darke, S. et al. (2002) Heroin use in New South Wales, Australia, 1996-2000: 5 year monitoring of trends in price, purity, availability and use from the Illicit Drug Reporting System (IDRS). *Addiction,* 97: 179-186

Darke, S. et al. (2002) *New South Wales Drug Trends 2001. Findings From the Illicit Drug Reporting System (IDRS).* National Drug and Alcohol Research Centre Technical Report No. 125.

Darke, S., Ross, J., Teesson, M., Lynskey, M. (2004) Attempted suicide among entrants to three treatment modalities for heroin dependence in the Australian Treatment Outcome Study (ATOS): prevalence and risk factors. *Drug and Alcohol Dependence* 73, 1-10.

Gerstein, D., Harwood, H., Suter, N. (1994). *Evaluating recovery services: The California Drug and Alcohol Treatment Assessment (CALDATA) General Report.* California: Department of Alcohol and Drug Programs.

Gossop, M., Marsden, J., Stewar,t D., Edwards, C., Lehmann, P., Wilson, A., Segar, G. (1997). The National Treatment Outcome Research Study in the United Kingdom: Six-month follow-up outcomes. *Psychology of Addictive Behaviors* 11, 324-337.

Hall, W., Ross, J., Lynskey, M., Law, M., Degenhardt, L. (2000). How many dependent heroin users are there in Australia? *Medical Journal of Australia* 173, 528-531.

Henderson, N., Darke, S., Teesson, M., Lynskey, M. (2002). *Longitudinal studies of dependent heroin users in Australia: Feasibility and benefits.* Sydney: National Drug and Alcohol Research Centre.

Hubbard, R., Marsden, M., Rachal, J., Harwood, H., Cavanaugh, E., Ginzburg, H. (1989). *Drug abuse treatment: A national study of effectiveness*. Chapel Hill: University of North Carolina Press.

Hubbard, R., Craddock, S., Flynn, P., Anderson, J., Etheridge, R. (1997). Overview of 1-year follow-up outcomes in the Drug Abuse Treatment Outcome Study (DATOS). *Psychology of Addictive Behaviors* 11, 261-278.

Robins, L., Helzer, J., Croughan, J., Ratcliff, K. (1981). National Institute of Mental Health Diagnostic Interview Schedule: its history, characteristics, and validity. *Archives of General Psychiatry* 38, 381-389.

Ross, J., Teesson, M., Darke, S., Lynskey, M., Hetherington, K., Mills, K., Williamson, A., Fairburn, S. (2002). *Characteristics of heroin users entering three treatment modalities in New South Wales: baseline findings from the Australian Treatment Outcome Study (ATOS).* National Drug and Alcohol Research Centre Technical Report No. 139.

Ross, J., Lynskey, M., Teesson, M., Darke, S., Havard, A., Mills, K., Williamson, A., Hetherington, K., Fairbairn, S. (2003). *Three month outcomes for the treatment of heroin dependence: Findings from the Australian Treatment Outcome Study (ATOS), New South Wales. Sydney*: National Drug and Alcohol Research Centre. Technical Report No.159. Sydney.

Shand, F., & Mattick, P.M. (2002). Results from the 4th National Clients of Treatment Service Agencies census: changes in clients' substance use and other characteristics. *Australian and New Zealand Journal of Public Health* 26, 352-357.

Simpson, D., Sells, S. (1982). Effectiveness of treatment for drug abuse: An overview of the DARP research program. *Advances in Alcohol and Substance Abuse* 2, 7-29.

SPSS Inc. (2001). SPSS for Windows (Version 11.0). Chicago.

Tagliaro, F., De Battisti, Z., Smith, F., Marigo, M. (1998). Death from heroin overdose: findings from hair analysis. *Lancet* 351, 1923-1925.

Ware, J., Kosinski, M., Keller, S. (1996). A 12-Item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. *Medical Care* 34, 220-233.

Wells, K. (1999). Treatment research at the crossroads: The scientific interface of clinical trials and effectiveness research. *American Journal of Psychiatry* 156, 5-10.

APPENDIX A: ATOS Bulletin