

Effectiveness of community treatments for heroin and crack cocaine addiction in England: a prospective, in-treatment cohort study



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Summary

Background Addiction to heroin and crack cocaine is debilitating and persistent, but such disorders are treatable. We present the first effectiveness study of the main community interventions for addiction to heroin and crack cocaine in England, using data from the National Drug Treatment Monitoring System (NDTMS).

Methods The study cohort consisted of all adults with a heroin or crack cocaine addiction, or both, who started pharmacological treatment (n=18 428 patients) or psychosocial treatment (n=2647) between Jan 1 and Nov 30, 2008, received at least 6 months' treatment or were discharged by the study endpoint (May 31, 2009), and had outcome data submitted to the NDTMS. Effectiveness was assessed from change in days of heroin or crack cocaine use, or both in the 28 days before the start of treatment and in the 28 days before review.

Findings 14 656 clients—74% of the cohort eligible for analysis at review with available data—were analysed at the study endpoint. During the 28 days before review, 37% (5016/13 542) of heroin users abstained from heroin and 52% (3941/7636) of crack cocaine users abstained from crack cocaine. A higher proportion of users of heroin only abstained than did users of both heroin and crack cocaine (42% [2465/5863] vs 33% [2551/7679]; OR 1.46, 95% CI 1.36–1.56), and more users of crack cocaine only abstained than did users of both drugs (57% [295/522] vs 51% [3646/7114]; 1.24, 1.03–1.48). Overall heroin use reduced by 14.5 days (95% CI 14.3–14.7) and crack cocaine use by 7.7 days (7.5–7.9). For clients given pharmacological treatment, reduction in days of heroin use was smaller for users of both heroin and crack cocaine than for users of heroin alone ($p < 0.0001$), but this differential effectiveness was not recorded for psychosocial treatment in heroin or crack cocaine users compared with users of both drugs.

Interpretation The first 6 months of pharmacological or psychosocial treatment is associated with reduced heroin and crack cocaine use, but the effectiveness of pharmacological treatment is less pronounced for users of both drugs. New strategies are needed to treat individuals with combined heroin and crack cocaine addiction.

Funding National Treatment Agency for Substance Misuse.

Introduction

Illicit drug addiction is characterised by compulsive drug use despite health and social harms.^{1,2} Untreated, this disorder is persistent and debilitating.^{3,4} In England, illicit opioids (predominantly street heroin; we use “heroin” throughout to include heroin and the very small number of other illicit opioids) and crack cocaine (a colloquial name for the smokeable base form of cocaine) have an aggressive addiction liability and cause most social costs associated with drug misuse.^{5,6} In 2006–07, for every 1000 people aged 15–64 years in England, an estimated 8.1 were heroin users and 5.4 were crack cocaine users.⁷ During 2007–08, 29% of clients who were admitted to a treatment programme for drug use disorders were using both drugs.⁸ Results from US and Australian studies assessing treatments for illicit drug use suggest that individuals concurrently using heroin and crack cocaine have worse outcomes than do primary users of either drug.^{9,10}

During treatment, monitoring of changes in drug use and other problem behaviours is useful for clinicians to

assess effectiveness of treatment. This information then contributes to evidence-based clinical practice and assessment of public health policy. However, internationally, treatment system monitoring efforts for drug addiction are rare.

The National Treatment Agency for Substance Misuse (NTA) in England was established by government as a special health authority within the National Health Service (NHS), with the aim of improving the capacity and effectiveness of treatment for drug use disorders. The NTA coordinates the National Drug Treatment Monitoring System (NDTMS) to compile information about all individuals seeking structured treatment in England and to track their progress. With the exception of a few private clinics, all active providers of community structured drug treatment (about 1000 agencies) report to the system, and more than 98% of clients consent to their data being used for performance monitoring. Data from service providers are collected by nine regional NDTMS teams, and centrally aggregated for analysis. A minimum set of identifiable information is included (client's

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initials, sex, date of birth, and local treatment area) to avoid double-counting individuals concurrently receiving treatment from different agencies.

Since 2001, after a substantial increase in drug treatment funding in England, the government has sought to assess the effect of services delivered by NHS and non-governmental organisations. However, long-term effectiveness studies are scarce and, up to now, the best available outcome data for England are derived from one 5-year prospective study in 1995 of 1000 individuals enrolled in opioid substitution or residential treatment.¹¹ Originally, NDTMS used treatment waiting times, numbers of clients receiving structured interventions, and retention rates as proxy indicators of efficiency and effectiveness. However, in October, 2007, the NTA incorporated the newly developed instrument—the Treatment Outcomes Profile (TOP)—to assess effectiveness directly. 20 items are used to record a set of core data for the past 28 days about the number of days of use of opioids, cocaine, amphetamines, cannabis, and alcohol; injection-related health-risk behaviour; the client's subjective ratings of physical health, psychological health, and quality of life; and the client's reports of criminal behaviours and indicators of social functioning.¹² The TOP is designed to help review clients' progress towards attaining personal treatment goals. These core data are reported to NDTMS at the start of treatment, at subsequent reviews during treatment, and at discharge.

We present results of the first analysis of the effectiveness of the national treatment system in England. We assess change in drug use for clients receiving community pharmacological and psychosocial interventions operating in all NHS regions in England. To accord with the priorities of the national drugs strategy,¹³ the focus is on change in heroin and crack cocaine use during treatment. This study does not assess residential programmes since they use different methods of analysis. We postulated that pharmacological and psychosocial treatments would be associated with reduced heroin and crack cocaine use, but that this improvement would be attenuated for clients using both drugs.

Methods

Treatment system for drug use disorders in England

A range of structured community interventions is available in each locality (primary care trust), and individuals receive one or more interventions tailored to their specific needs and delivered according to national clinical guidelines^{14–16} in a community or residential setting. A specified key worker—sometimes a physician or psychologist, but usually a psychiatric nurse, social worker, or trained non-medical drugs worker—takes the lead role in coordination of the client's care. Through regular clinic appointments, the key worker gives practical advice, uses psychological techniques to build

motivation to reduce drug-related harms, and organises access to community services.¹⁴ We assessed individuals receiving pharmacological or psychosocial treatment.

	Pharmacological treatment (n=18 428)	Psychosocial treatment (n=2647)
Demographic indicators		
Men	13 858 (75%)	2002 (76%)
Age (years)	33.0 (7.9)	33.4 (8.7)
Ethnic origin*		
White	15 728 (87%)	1973 (75%)
Mixed	481 (3%)	116 (4%)
Asian	1109 (6%)	131 (5%)
Black	421 (2%)	353 (13%)
Other	452 (3%)	55 (2%)
Referral source		
Self	7891 (43%)	1060 (40%)
Family member or concerned person	58 (<1%)	28 (1%)
Specialist addiction service		
Needle exchange service	141 (1%)	10 (<1%)
Community drug service	1034 (6%)	147 (6%)
Health and social services		
General practitioner	1560 (8%)	124 (5%)
Accident and emergency department	45 (<1%)	5 (<1%)
General hospital	79 (<1%)	7 (<1%)
Psychiatry services	71 (<1%)	37 (1%)
Social services	56 (<1%)	28 (1%)
Criminal justice		
Drug interventions programme	2617 (14%)	407 (15%)
Probation	892 (5%)	263 (10%)
Prison	718 (4%)	91 (3%)
Drug rehabilitation requirement	199 (1%)	131 (5%)
Other	3067 (17%)	309 (12%)
Clinical description†		
First treatment episode	6249 (34%)	1450 (55%)
Drug use group‡		
Heroin use only	7740 (42%)	623 (24%)
Number of days of use	23.1 (8.9)	18.7 (10.8)
Crack cocaine use only	NA	926 (35%)
Number of days of use	NA	12.8 (9.5)
Heroin and crack cocaine use	10 688 (58%)	1098 (41%)
Number of days of heroin use	22.9 (8.9)	17.0 (10.9)
Number of days of crack cocaine use	12.8 (10.7)	13.1 (10.3)
Other substance use†		
Alcohol	7730 (42%)	1387 (52%)
Cannabis	5051 (27%)	968 (37%)
Cocaine powder	1087 (6%)	448 (17%)
Amphetamines	750 (4%)	133 (5%)

Data are number (%) or mean (SD). NA=not applicable. *Data are missing for 237 clients on pharmacological treatment, and 19 on psychosocial treatment. †Recorded by the National Drug Treatment Monitoring System. ‡Based on reports for the 28 days before treatment start.

Table 1: Characteristics of clients at admission by treatment type

Pharmacological treatment with opioid agonist medication is the front-line community intervention for individuals with heroin addiction, and is available from specialist clinics and in primary care. Individuals are usually prescribed a daily dose of an oral opioid agonist (initially supervised): 60–120 mg methadone or 12–16 mg (up to 32 mg) buprenorphine.¹⁴ Treatment is retention oriented; the individual receives a stable dose for as long as clinically indicated, then the prescribing physician supervises a gradual withdrawal to achieve opioid abstinence (sometimes the client is referred to a residential setting for this purpose). Clients are supported by a key worker and, if necessary, may also receive structured psychosocial treatment. Some clients are addicted to heroin only, and others present with use of other substances. With no empirically validated pharmacotherapy to treat crack cocaine addiction, psychosocial treatment is the recommended community intervention for this disorder.

Psychosocial treatment is given to individuals with addiction to heroin or crack cocaine, or both, who might also use other substances. Psychosocial treatment is usually available from a specialist service offering interpersonal, motivational, or cognitive-behavioural therapies, or a combination, with no specific medication component. During three to 20 sessions tailored to the client's needs,¹⁷ therapy aims to resolve ambivalence about change, improve recognition and control of drug use cues and urges, reduce drug-related harm, and prevent relapse. Increased intensity treatment, sometimes with educational and life-skills training, is delivered as a 12-week programme with 3–5 days' attendance per week. Psychosocial treatment is given by trained practitioners on an individual or group basis, and the client's partner or family can also participate. Psychosocial treatment is the recommended community intervention for this disorder.

NTA practice guidance for structured treatments recommends that clients receive regular progress reviews from service providers, usually every 3 months after treatment begins.¹⁸ For performance monitoring, service providers are expected to submit data about treatment outcomes for every individual at least every 6 months during treatment. This information is submitted to NDTMS continuously via treatment providers' clinical database software and a secure internet site.

For quality assurance, the NDTMS protocol specifies that data should not be included in the national effectiveness assessment if an individual's interview for admission to treatment is done more than 14 days before or after the treatment start date. The protocol also excludes treatment outcomes data gathered during reviews in the first 28 days of treatment because of overlap with the 28-day recall period for drug use and other behaviours before treatment. In this study, clients who remained in treatment for more than 28 days, but were then abruptly incarcerated, were ineligible for review because service providers will usually lose contact with the individual.

Study design

All clients were aged 18 years or older, and had used heroin or crack cocaine, or both in the 28 days before treatment began, but had not received structured drug treatment in the previous 90 days. Clients were categorised as users of heroin only (addiction to heroin with no crack cocaine use), crack cocaine only (addiction to crack cocaine with no heroin use), or heroin and crack cocaine. For psychosocial treatment, we included both structured psychosocial interventions and structured day-programme interventions, as designated by NDTMS. We adhered to eligibility criteria in the NDTMS protocol and described above.

We included all data appropriately submitted to the NDTMS by multidisciplinary NHS teams, general practitioners, and non-governmental organisations. The TOP was launched in October, 2007, so we allowed 3 months for services to adapt to the new procedures and submit the necessary data, and created a cohort of clients starting new treatment during Jan 1–Nov 30, 2008. We judged that 6 months of treatment would be an appropriate endpoint to assess programme effectiveness; accordingly, all clients spent at least 6 months (182 days) in treatment, or had been discharged before the study endpoint (May 31, 2009). If an individual had two or more sets of review data, we used the set closest to the study endpoint or at discharge. The reason for treatment discharge was recorded as: planned (treatment completed), unplanned (dropout), or referred to another treatment or support service. No client discharged during the study was readmitted to treatment.

To obtain data for the TOP, clinic staff undertook interviews with clients under confidentiality assurance.¹⁹ The timeline follow-back technique was used to record information about drug use, in which a calendar populated with memorable events is used to prompt recall; this technique is proven to be psychometrically valid.²⁰ The TOP has shown excellent test-retest reliability for drug use reporting; for days of: heroin use $\kappa=0.79$, heroin abstinence $\kappa=0.88$, crack cocaine use $\kappa=0.83$, and crack cocaine abstinence $\kappa=0.83$. Concordance between self-reported heroin or crack cocaine use and oral fluid drug toxicology tests reached or exceeded the threshold for substantial agreement ($\kappa=0.61$ for self-reported drug use; $\kappa=0.66$ for drug toxicology tests).²¹ Subsequently, interviews by treatment staff have been guided by training materials with central and regional NDTMS personnel available to offer advice.

We assessed treatment effectiveness from change in the number of days of use of heroin, or crack cocaine, or both during the 28 days before treatment start compared with the number of days of use during the 28 days before the latest in-treatment review (days before treatment start minus days before review). As secondary measures we reported changes in the use of cocaine powder, non-prescribed amphetamines, cannabis, and alcohol between the 28 days before admission and the 28 days before review.

For more on TOP see
<http://www.nta.nhs.uk/TOP>

For the NDTMS protocol see
<http://www.nta.nhs.uk/areas/ndtms>

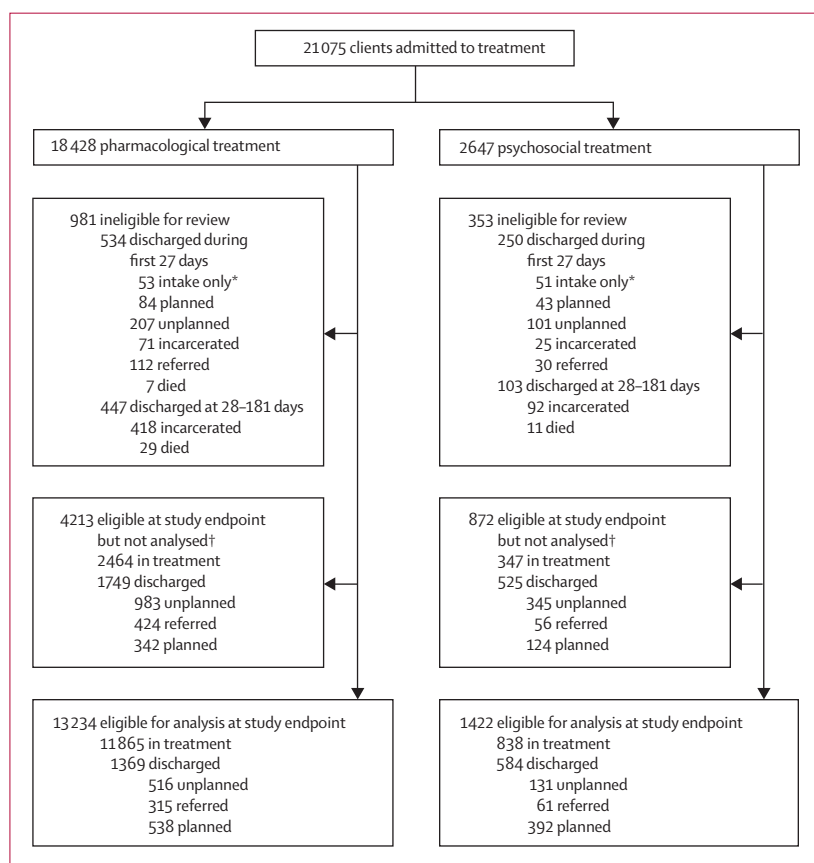


Figure: Progress of clients through the study

This figure is for illustrative purposes and does not suggest that clients were directly allocated to either treatment. *Clients discharged on the day treatment started. †Treatment services failed to submit treatment outcomes profile data.

Statistical analysis

The national prevalence of crack cocaine use is lower than that of heroin, so we expected users of crack cocaine to form the smallest group in the study cohort. We therefore ensured that statistical analysis would be reliable at and above this level in the dataset. Data from the study to develop the TOP showed that use of six psychoactive substances had an average reduction from 40.4% (SD 25.2) at intake to 30.6% (19.7) after 1 month.¹² We used this effect to guide the minimum number of aggregated clients needed for reliable statistical hypothesis testing. From a single-sample two-tailed binomial test with 5% error, we calculated that with 95% power against about 10% critical effect,²² the smallest subgroup of interest needed to exceed 300 people.

The data structure for the study was hierarchical; clients were nested in treatment services, with each treatment site located in one of the nine English geographical (government) regions. To analyse change in number of days of drug use we estimated effects and variance components using a multilevel mixed linear model with Stata (version 10.1; procedure xtmixed). Throughout, treatment site was modelled as a random effect and its

regional location as a fixed effect, and the analyses were run separately for each of the two treatment types.

For the analysis, the drug use change score was adjusted by two covariates: number of days from admission to review, and number of days of drug use in the 28 days before admission. The first covariate corrected for time-to-review differentials between clients. The second covariate (which resulted in all change responses relating to the same mean initial value) allowed for differences in the change score induced by measurement error (regression to the mean), and limitations induced by the fixed upper and lower endpoints of the scale. To improve the distributional characteristics of the change scores for statistical analysis, days of use (of 28) were computed as a proportion and then root-arcsine transformed, and the time-to-review variable was square-root transformed. All analyses were done with these transformed variables. However, for presentation, descriptive statistics and tabular data show the untransformed data. All other statistical analyses were done with Stata (version 10.1), and we used SPSS (version 15) for data management.

To report change at an individual level, change in days of drug use was categorised by use of Jacobson and Truax's²³ reliable change index. The index assesses whether a recorded difference on a scaled measure reliably exceeds measurement error. Change was judged to be statistically reliable if the difference between the score before admission and that at in-treatment review standardised by the estimated SD of its measurement error (for the reviewed sample), exceeded a Z score that indicated a 95% level of significance. Change categories for clients' drug use were abstinent, reliably improved, reliably deteriorated, and unchanged (zero change, or change that probably did not exceed measurement error).

Role of the funding source

Employees of the study sponsor, the NTA, contributed to the study design, data analysis, data collection, data interpretation, and writing of the report. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Results

21075 clients were eligible to form the study cohort. Table 1 shows their characteristics at admission. The proportions of black (African, Caribbean, or other) and white (British, Irish, or other) clients receiving the pharmacological and psychosocial interventions differed substantially, as would be expected from research documenting differences in use of heroin and crack cocaine between these population groups.²⁴

The figure shows the flow of clients through the study. The cohort used 816 specialist community drug treatment services, which accounts for 80% of services that were operational during the recruitment window and met the inclusion criteria for the study cohort. A

median of 11 clients (IQR 4–33) were using each treatment service, a mean of 2342 clients (SD 1058) were using services in each of the nine geographical regions, and a median of 119 clients (IQR 76–183) were using all but one of the 149 local systems for drug treatment. The data included residents from every primary care trust except one and from all mental health trusts providing drug treatments.

In the first 28 days of treatment, 784 (4%) clients were discharged from treatment, of whom 104 (13%) left on the day that treatment started (figure). The remainder (n=680 clients) left after a mean of 15.4 days (SD 7.4), of whom 308 (45%) had unplanned discharge, 142 (21%) were referred, 127 (19%) had planned discharge, 96 (14%) were incarcerated, and seven (1%) died. From 28 days to the study endpoint, 510 (3%) of the remaining 20291 clients were incarcerated and 40 (<1%) died. Of the 19741 clients remaining in the cohort who were eligible for review, treatment services failed to submit TOP data for 5085 (26%) clients at any time up to the study endpoint (figure).

14656 clients—74% of the eligible cohort (76% of those given pharmacological treatment and 62% of those given psychosocial treatment)—were analysed at the study endpoint. Mean time to review was 18.8 weeks (SD 6.6); 1953 (13%) clients in the analysed sample were discharged from treatment after a mean of 13.7 weeks (SD 5.5). To check for sample bias, we compared characteristics at admission of eligible clients who were analysed at study endpoint (n=14656) with those who were not analysed (n=5085). Logistic regression (backward elimination with predictors: sex, age, ethnic group, drug use group, days of heroin or crack cocaine use in the 28 days before admission, and treatment type) showed that the samples did not differ significantly, with the exception that pharmacological treatment services were more likely than psychosocial services to submit TOP data (adjusted odds ratio [OR] 1.89, 95% CI 1.72–2.07). Accordingly, analyses were done with unweighted and weighted data to account for differential submission of data.

For clients analysed at the study endpoint, 4996 (34%) were abstinent from both drugs in the 28 days before review. 13 542 (92%) clients analysed were heroin users, of whom 5016 (37%) were abstinent from heroin in the 28 days before review; 7636 (52%) clients analysed were crack cocaine users, of whom 3941 (52%) were abstinent from crack cocaine in the 28 days before review. Proportions of abstinent individuals differed only in the first decimal place with use of weighted data. In the analyses, all test statistics were significant with a probability of less than 0.0001 unless otherwise indicated.

Table 2 shows the change in drug use and table 3 shows the results from the analysis of the mixed linear model. For clients using heroin, the reduction in days of heroin use from admission to review was significant for the overall study sample (equivalent to 63.6% reduction) and for each treatment type (table 2). A small but significant

	Clients	Number of days of drug use		
		Before admission*	Review*	Difference†
Overall study sample				
Heroin use	13 542	22.8 (9.0)	8.3 (10.4)	14.5 (14.3–14.7)
Heroin only users	5 863	23.0 (8.9)	7.3 (10.1)	15.7 (15.4–16.0)
Heroin and crack cocaine users	7 679	22.6 (9.1)	9.0 (10.6)	13.6 (13.3–13.9)
Crack cocaine use	7 636	12.6 (10.5)	4.9 (8.2)	7.7 (7.5–7.9)
Crack cocaine only users	522	12.7 (9.4)	4.6 (7.9)	8.1 (7.3–8.9)
Heroin and crack cocaine users	7 114	12.6 (10.6)	4.9 (8.2)	7.7 (7.4–7.9)
Pharmacological treatment				
Heroin use	12 745	23.1 (8.8)	8.3 (10.4)	14.8 (14.6–15.0)
Heroin only users	5 561	23.2 (8.7)	7.3 (10.0)	15.9 (15.6–16.2)
Heroin and crack cocaine users	7 184	23.0 (8.8)	9.1 (10.6)	13.9 (13.6–14.2)
Crack cocaine use	6 614	12.6 (10.6)	4.9 (8.2)	7.7 (7.4–7.9)
Crack cocaine only users	NA	NA	NA	NA
Heroin and crack cocaine users	6 614	12.6 (10.6)	4.9 (8.2)	7.7 (7.4–7.9)
Psychosocial treatment				
Heroin use	797	17.4 (10.9)	7.6 (10.3)	9.8 (9.0–10.6)
Heroin only users	302	18.7 (10.8)	7.2 (10.3)	11.5 (10.2–12.9)
Heroin and crack cocaine users	495	16.6 (10.9)	7.8 (10.3)	8.7 (7.7–9.8)
Crack cocaine use	1 022	12.8 (9.8)	4.9 (8.2)	7.9 (7.3–8.6)
Crack cocaine only users	522	12.7 (9.4)	4.6 (7.9)	8.1 (7.3–8.9)
Heroin and crack cocaine users	500	12.9 (10.2)	5.2 (8.5)	7.7 (6.8–8.7)

Data are number, mean (SD), or mean (95% CI). NA=not applicable. *Data for 28 days before treatment start and 28 days before review. †Reported (unadjusted) mean days of drug use. ‡Data are available for 14 656 individuals; 372 clients on heroin, 456 on crack cocaine, and 359 on both heroin and crack cocaine gave no response to days of drug use at review; no clients were in prison or a residential treatment programme in the 28 days before review; individuals from the heroin and crack cocaine groups overlap because their heroin and crack cocaine use was analysed separately.

Table 2: Change in use of heroin and crack cocaine by treatment type and drug use group‡

positive effect was recorded for time to review in the overall study sample ($p<0.0001$) and for clients given pharmacological treatment, but not for clients given psychosocial treatment ($Z=1.95$; $p=0.051$). Region effects contributed significantly in all models, with the exception of the analysis of change in days of heroin use among individuals given psychosocial treatment ($p=0.374$), and there was a significant variance component associated with each treatment site in the degree of the reduction of drug use (psychosocial treatment $p=0.007$). Reduction in days of heroin use was smaller for individuals using both heroin and crack cocaine at admission than for those using heroin only; the difference was significant for the overall study sample and for those given pharmacological treatment (both $p<0.0001$), but not psychosocial treatment ($Z=-1.69$; $p=0.091$; table 2).

For clients using crack cocaine, the reduction in days of crack cocaine use from admission to review was significant for the overall study sample (equivalent to 61.1% reduction) and for each treatment type (table 2). Similar to results for heroin use in the overall study sample, a small but significant positive effect was recorded for time to review (overall study sample $p<0.0001$, psychosocial

	Change contrast (95% CI)*	Double vs single drug problems (95% CI)†	Time to review (95% CI)	Region (LR χ^2)	Agency (% variance)‡
Overall study sample					
Heroin use (n=13 452)	0.792 (0.777 to 0.807)	-0.089 (-0.109 to -0.070)	0.858 (0.838 to 0.878)	30.52	0.135 (2.9)
Crack cocaine use (n=7636)	0.465 (0.452 to 0.479)	0.056 (-0.096 to -0.015)	0.020 (0.016 to 0.025)	59.78	0.007 (2.4)
Pharmacological treatment					
Heroin use (n=12 745)	0.803 (0.787 to 0.819)	-0.092 (-0.112 to -0.072)	0.026 (0.021 to 0.030)	25.71	0.014 (3.0)
Crack cocaine use (n=6614)	0.463 (0.448 to 0.477)	NA	0.021 (0.016 to 0.026)	48.01	0.008 (2.4)
Psychosocial treatment					
Heroin use (n=797)	0.566 (0.524 to 0.609)	-0.070 (-1.150 to -0.011)	0.017 (0.000 to 0.034)	8.64	0.019 (4.8)
Crack cocaine use (n=1022)	0.483 (0.444 to 0.521)	-0.034 (-0.086 to 0.018)	0.017 (0.005 to 0.029)	22.04	0.007 (2.7)

LR=likelihood ratio test. *Model parameters in the table are for the (root-arc sine or square-root) transformed variables. †Comparison of use of heroin and crack cocaine versus use of heroin only or crack cocaine only. ‡Agency denotes the individual treatment site. §The analysis was done with the data available for 14 656 individuals; these data are shown in table 2.

Table 3: Parameters from the mixed linear model analysis§

	Abstinent	Reliably improved*	Unchanged	Reliably deteriorated*
Overall study sample				
Heroin only users (n=5863)	2465 (42%)	1721 (29%)	1537 (26%)	140 (2%)
Crack cocaine only users (n=522)	295 (57%)	44 (8%)	174 (33%)	9 (2%)
Heroin and crack cocaine users				
Heroin use (n=7679)	2551 (33%)	2435 (32%)	2440 (32%)	253 (3%)
Crack cocaine use (n=7114)	3646 (51%)	901 (13%)	2351 (33%)	216 (3%)
Pharmacological treatment				
Heroin only users (n=5561)	2317 (42%)	1677 (30%)	1432 (26%)	135 (2%)
Crack cocaine only users (n=0)	NA	NA	NA	NA
Heroin and crack cocaine users				
Heroin use (n=7184)	2331 (32%)	2359 (33%)	2257 (31%)	237 (3%)
Crack cocaine use (n=6614)	3382 (51%)	855 (13%)	2173 (33%)	204 (3%)
Psychosocial treatment				
Heroin only users (n=302)	148 (49%)	44 (15%)	105 (35%)	5 (2%)
Crack cocaine only users (n=522)	295 (57%)	44 (8%)	174 (33%)	9 (2%)
Heroin and crack cocaine users				
Heroin use (n=495)	220 (44%)	76 (15%)	183 (37%)	16 (3%)
Crack cocaine use (n=500)	264 (53%)	46 (9%)	178 (36%)	12 (2%)

Data are number (%). NA=not applicable. *Clients were categorised as improved or deteriorated if from admission to review, days of heroin or crack cocaine use had decreased or increased, respectively, by 12 days or more. †Reliable change index was calculated from the overall SD for each drug before treatment start.

Table 4: Change categories† at review by treatment type and drug use group

treatment $p < 0.0001$), and region affected crack cocaine use in the overall study sample ($p < 0.0001$) and in clients given psychosocial treatment ($p < 0.0001$). However, the reduction in days of crack cocaine use did not differ significantly in the psychosocial treatment group between individuals who were using both heroin and crack cocaine at admission and those using crack cocaine only ($p = 0.204$; table 2). In the overall study sample, this difference was significant with a smaller reduction in days of crack cocaine use for users of both heroin and crack cocaine than for users of crack cocaine only ($p < 0.0001$).

In all models, higher numbers of days of drug use before admission were associated with greater reduction in days of use. We did covariate adjusted multilevel mixed linear model analyses of the change in drug use in the overall study sample with weighted data to account for the differential submission of TOP data at review. The results differed only in the third decimal place from the results with unweighted data shown in table 3.

Table 4 shows the change categories for heroin and crack cocaine use at review. Of 13 542 heroin users analysed at review, 5016 (37%) were abstinent from heroin, 4156 (31%) had improved, 393 (3%) had deteriorated, and the remainder were unchanged. For 7636 crack cocaine users, 3941 (52%) were abstinent from crack cocaine, 945 (12%) had improved, 225 (3%) had deteriorated, and the remainder were unchanged. The heroin-abstinent proportion was significantly higher for users of heroin only than for users of both heroin and crack cocaine (OR 1.46, 95% CI 1.36–1.56), and abstinence from crack cocaine was significantly higher for users of crack cocaine only than for users of both heroin and crack cocaine (1.24, 1.03–1.48; table 4).

Table 5 shows the overall change in the use of alcohol, cannabis, cocaine powder, and amphetamines. The mean days of use decreased for all substances. Since cocaine powder and crack cocaine are different forms of the same drug, the data about cocaine powder are most important for this study. The 448 clients who did not use cocaine powder at admission but had started to use the drug in the 28 days before review resulted in a net reduction of 307 users of cocaine powder between admission and review. For clients who started to use cocaine powder during treatment, 356 (79%) were using less than 1 day per week on average in the 28 days before review. These individuals included 187 (5%) of 3941 users of crack cocaine who were abstinent from crack cocaine at review.

	Alcohol	Cannabis	Cocaine powder	Amphetamines
Clients using drugs at admission	44% (6115/13 985)	29% (4025/13 877)	7% (1003/13 784)	4% (585/13 766)
Number of days of use at admission	13.1 (10.5)	14.5 (11.1)	7.2 (8.5)	8.2 (9.2)
Number of days of use at review	10.1 (10.7)	8.5 (11.4)	1.7 (4.7)	3.0 (6.9)
Difference in days of use	3.1 (2.8–3.3)	6.0 (5.6–6.4)	5.5 (5.0–6.0)	5.2 (4.5–6.0)
Clients abstaining at review	1809 (30%)	1942 (48%)	755 (75%)	389 (66%)
Clients not using drugs at admission	56% (7870/13 985)	71% (9852/13 877)	93% (12 781/13 784)	96% (13 181/13 766)
Clients using drugs at review	1930 (25%)	1423 (14%)	448 (4%)	182 (1%)
Number of days of use at review	8.3 (8.3)	12.0 (10.8)	3.9 (5.6)	5.9 (8.0)

Data are percentage (n/N), mean (SD), or mean (95% CI). Data for clients who had information for the 28 days before admission and the 28 days before review.

Table 5: Changes in use of drugs other than heroin and crack cocaine from admission to review

Discussion

We recorded high proportions of treatment retention from the first 28 days of treatment to the study endpoint. At review, by which time clients had completed a mean of 19 weeks' treatment, more than a third of heroin users were abstaining from heroin and more than half of crack cocaine users were abstaining from crack cocaine; a higher proportion of users of either heroin and crack cocaine abstained than did users of both drugs. From before admission to review, we reported an overall reduction of 14.5 days of heroin use and 7.7 days of crack cocaine use. From categories for change of drug use, we found reliable improvement in 31% of clients who continued to use heroin and 12% of those who continued to use crack cocaine.

The reliable change method has been used to assess treatments for alcohol misuse,^{25,26} and we have found it useful for assessment of treatments for drug addiction. The method is straightforward if the outcome measure has functional norms, so that a treated individual is judged as recovered if a score after treatment is in the functional range for the general population. There is no functional norm for illicit drug use, so the boundary for reliable change was set at change in drug use by 12 days or more. We believe that a simple summary index of individual treatment responses will be useful to clinicians, and we expect that the reliable change method will stimulate debate and further research. An important point to note is that, 2–3% of clients were using heroin or crack more frequently at review than at admission. Drug addiction is a relapsing condition and several treatment episodes are often needed before recovery.²⁷ In future research, we plan to analyse a sample of sufficient size to reliably analyse the characteristics of these individuals.

We recorded higher abstinence in users of heroin or crack cocaine alone than in users of both drugs. However, the reduction in days of heroin use was significantly lower for users of both heroin and crack cocaine than for users of heroin alone in clients receiving pharmacological treatment, but not those receiving psychosocial treatment. No clear explanation for this differential effect is apparent, but pharmacokinetic research suggests that cocaine use increases the metabolism of opioid agonist

medication,²⁸ which could precipitate withdrawal and motivate illicit drug use. In view of the high number of clients using both drugs, new strategies are needed to treat this population.

With respect to psychosocial treatment, randomised controlled efficacy trials of cognitive behavioural therapies for drug addictions have not, so far, indicated strong effects compared with control groups at follow-up.¹¹ Our results suggest that psychosocial interventions used in England are associated with reduced use of heroin and crack cocaine in clients using either drug and those using both drugs, but follow-up studies are needed to establish whether these improvements are maintained after treatment.

We recorded regional and inter-agency differences in the extent to which drug use changed. These results reinforce clear geographical differences in prevalence of drug use and associated problems, and organisational differences between service providers delivering the same treatment type; these factors could affect outcome.²⁹ In future research, we need to assess the dynamic organisational and staff characteristics that can affect change in drug use.

Although use of alcohol, cannabis, cocaine powder, and amphetamines was not the main focus of our study, we reported reduced use at review. For alcohol, the number of individuals who were using alcohol at admission but abstained at review was about the same as the number who started use between admission and review. For cannabis, cocaine powder, and amphetamines, we recorded a net reduction by 519, 307, and 207 users, respectively. We believe that these drug use patterns do not affect the results for change in heroin or crack cocaine use.

47 deaths were recorded from admission to the study endpoint. Users of heroin or crack cocaine, or both have substantially raised age-matched mortality associated with accidental overdose (especially from use of opioids and other depressant drugs), but drug-related deaths can also arise indirectly from accidents, misadventure, or violence.³⁰ Previous studies have shown that treatment with opioid agonists greatly reduces but does not eliminate heroin addicts' risk of death,^{31,32} and such

For the NTA work programme on drug-related deaths and harm reduction see http://www.nta.nhs.uk/areas/drug_related_deaths

treatment has to be initiated carefully because of risk of fatal iatrogenic toxic effects, especially during induction.³³ Reduction of death from overdose remains a strategic priority in the provision of harm reduction programmes in England and there is an NTA work programme for the prevention of drug-related deaths.

We recognise that this study had several limitations. First, we did not have an untreated control group as have some naturalistic outcome studies. For example, the Australian Treatment Outcome Study³⁴ for heroin users included a comparison group of individuals who were not receiving or seeking treatment; there was some reduction in drug use in this group at follow-up, but the reduction was much lower than for those who started treatment at recruitment.³⁴ Although NDTMS functions to provide data about the entire treatment system, the system does not allow construction of a comparison group. Second, review data during treatment were gathered by clinic staff participating in the treatment of each client, rather than by independent researchers, but the TOP has good reliability between clinic staff. Third, TOP data were not submitted for 26% of clients at review, but the demographic and clinical characteristics of individuals with or without such data did not differ, and weighting of the data to account for those without information did not change results.

However, the strengths of the study include the size of the sample, which is representative of drug users in England seeking specialist community treatment (about 7% of users of heroin or crack cocaine, or both⁷), and the use of an analytical model that accounts for the hierarchical structure of the dataset to estimate the contribution of various components to change in drug use. Although design differences restrict comparison with other national and international studies, we believe that our findings are reliable and generalisable estimates of change in drug use during treatment. In view of the chronic course of heroin and crack cocaine addictions, and the long-term care usually needed for treatment, our results are an important first indication of effectiveness for the English treatment system.³⁵

In future analysis of the national treatment system in England, we aim to focus on: change in use of drugs other than heroin or crack cocaine, with a detailed analysis of the inter-relation of drug use; behaviour change in other domains; behaviour after treatment of longer than 6 months; interventions other than pharmacological and psychosocial treatments; and an analysis of treatment retention.

Contributors

JM, BE, CB, JK, and CW designed the study under the oversight of the National Drug Treatment Monitoring System Outcomes Study Group. BE, JK, and CW created the aggregated dataset for the study. JM and BE undertook the statistical analysis with guidance from a consulting biostatistician, and KR and CW did data integrity and quality control assessments. JM drafted the report. All authors contributed to data interpretation, editing of the report, and have seen and approved the final version.

National Drug Treatment Monitoring System Outcomes Study Group

Researchers and managers from clinical, behavioural, and social science backgrounds from whom expertise is drawn according to the research question.

Conflicts of interest

JM and MF undertake research and consultancy for the Department of Health for England and the National Treatment Agency for Substance Misuse. BE, CB, AD-P, PH, JK, KR, and CW are employees of the National Treatment Agency for Substance Misuse.

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References

- 1 WHO. International statistical classification of disease and health-related problems (ICD-10). Geneva: World Health Organization, 1993.
- 2 American Psychiatric Association. Diagnostic and statistical manual of mental disorders (4th edn). Washington, DC: American Psychiatric Association, 1994.
- 3 McLellan AT, Lewis DC, O'Brien CP, Kleber HD. Drug dependence, a chronic medical illness: implications for treatment, insurance, and outcomes evaluation. *JAMA* 2000; **284**: 1689–95.
- 4 Hser YI, Hoffman V, Grella CE, Anglin MD. A 33-year follow-up of narcotics addicts. *Arch Gen Psychiatry* 2001; **58**: 503–08.
- 5 Nutt D, King LA, Saulsbury W, Blakemore C. Development of a rational scale to assess the harm of drugs of potential misuse. *Lancet* 2007; **369**: 1047–53.
- 6 Hay G, Gannon M, MacDougall J, Millar T, Eastwood C, McKeganey N. Local and national estimates of the prevalence of opioid use and/or crack cocaine use (2004/05). In: Singleton N, Murray R, Tinsley L, eds. Measuring different aspects of problem drug use: methodological developments (2nd edn). Home Office online report 16/06. <http://www.homeoffice.gov.uk/rds/pdfs06/rdsolr1606.pdf> (accessed July 29, 2009).
- 7 Hay G, Gannon M, MacDougall J, et al. National and regional estimates of the prevalence of opiate use and/or crack cocaine use 2006/07: a summary of key findings. Home Office research report 9: summary. <http://www.homeoffice.gov.uk/rds/pdfs08/horr09.pdf> (accessed July 29, 2009).
- 8 Statistics from the National Drug Treatment Monitoring System (April 1, 2007–March 31, 2008). http://www.nta.nhs.uk/areas/facts_and_figures/0708/docs/ndtms_annual_report_2007_08_011008.pdf (accessed July 29, 2009).
- 9 Grella, CE, Anglin MD, Wugalter SE. Cocaine and crack use and HIV risk behaviours among high-risk methadone maintenance clients. *Drug Alcohol Depend* 1995; **37**: 15–21.
- 10 Williamson A, Darke, S, Ross J, Teesson M. The effect of persistence of cocaine use on 12-month outcomes for the treatment of heroin dependence. *Drug Alcohol Depend* 2006; **81**: 293–300.
- 11 Gossop M, Marsden J, Stewart D, Kidd T. The National Treatment Outcome Research Study (NTORS): 4–5 year follow-up results. *Addiction* 2003; **98**: 291–303.
- 12 Marsden J, Farrell M, Bradbury C, et al. Development of the Treatment Outcomes Profile. *Addiction* 2008; **103**: 1450–60.
- 13 HM Government. Drugs: protecting families and communities. The 2008 drug strategy. <http://drugs.homeoffice.gov.uk/publication-search/drug-strategy/drug-strategy-2008> (accessed July 29, 2009).
- 14 Department of Health (England) and the devolved administrations (2007). Drug misuse and dependence: UK guidelines on clinical management. London: Department of Health (England), the Scottish Government, Welsh Assembly Government, and Northern Ireland Executive, 2007.
- 15 National Institute for Health and Clinical Excellence. Drug misuse: opioid detoxification (NICE clinical guideline 52). <http://www.nice.org.uk/Guidance/CG52> (accessed July 29, 2009).

- 16 National Institute for Health and Clinical Excellence. Drug misuse: psychosocial interventions (NICE clinical guideline 51). <http://www.nice.org.uk/Guidance/CG51> (accessed July 29, 2009).
- 17 National Treatment Agency for Substance Misuse. Models of care for adult drug misusers: update 2006. http://www.nta.nhs.uk/publications/documents/nta_modelsofcare_update_2006_moc3.pdf (accessed July 29, 2009).
- 18 National Treatment Agency for Substance Misuse. Care planning practice guide. http://www.nta.nhs.uk/publications/documents/nta_care_planning_practice_guide_2006_cpg1.pdf (accessed July 29, 2009).
- 19 Del Boca FK, Noll JA. Truth or consequences: the validity of self-report data in health services research on addictions. *Addiction* 2000; **95** (suppl 3): S347–60.
- 20 Fals-Stewart W, O'Farrell TJ, Freitas TT, McFarlin SK, Rutigliano P. The timeline followback reports of psychoactive substance use by drug-abusing patients: psychometric properties. *J Consult Clin Psychol* 2000; **68**: 134–44.
- 21 Cone EJ, Presley L, Lehrer M, et al. Oral fluid testing for drugs of abuse: positive prevalence rates by intercept immunoassay screening and GC-MS-MS confirmation and suggested cut-off concentrations. *J Anal Toxicol* 2002; **26**: 541–46.
- 22 Kraemer HC, Thiemann S. How many subjects? Statistical power analysis in research. Newbury Park, CA: Sage, 1987.
- 23 Jacobson NS, Truax P. Clinical significance: a statistical approach to defining meaningful change in psychotherapy research. *J Consult Clin Psychol* 1991; **59**: 12–19.
- 24 National Treatment Agency for Substance Misuse. Black and minority ethnic communities in England: a review of the literature on drug use and related service provision. http://www.nta.nhs.uk/areas/diversity/docs/BME_Literature_review.pdf (accessed July 29, 2009).
- 25 Roberts LJ, Neal DJ, Kivlahan DR, Baer JS, Marlatt GA. Individual drinking changes following a brief intervention among college students: clinical significance in an indicated preventive context. *J Consult Clin Psychol* 2000; **68**: 500–05.
- 26 Cisler RA, Kowalchuk RK, Saunders SM, Zweben A, Trinh HQ. Applying clinical significance methodology to alcoholism treatment trials: determining recovery outcome status with individual-and population-based measures. *Alcohol Clin Exp Res* 2005; **29**: 1991–2000.
- 27 National Institute on Drug Abuse. Principles of drug addiction treatment: a research-based guide (2nd edn). NIH publication number 09–4180. <http://www.nida.nih.gov/PDF/PODAT/PODAT.pdf> (accessed July 29, 2009).
- 28 McCance-Katz EF, Rainey PM, Moody DE. Effect of cocaine use on buprenorphine pharmacokinetics in humans. *Am J Addict* (in press).
- 29 Moos RH, Moos BS. The staff workplace and the quality and outcome of substance abuse treatment. *J Stud on Alcohol* 1998; **59**: 43–51.
- 30 Farrell M, Marsden J. Acute risk of drug-related death among newly released prisoners in England and Wales. *Addiction* 2008; **103**: 251–55.
- 31 Caplehorn JRM, Drummer OH. Mortality associated with New South Wales methadone programs in 1994: lives lost and saved. *Med J Aust* 1999; **170**: 104–09.
- 32 Umbricht A, Huestis MA, Cone E, Preston KL. Effects of high-dose intravenous buprenorphine in experienced opioid abusers. *J Clin Psychopharmacol* 2004; **24**: 479–87.
- 33 Bell J, Trinh L, Butler B, Randall D, Rubin G. Comparing retention in treatment and mortality in people after initial entry starting on a methadone maintenance program. *Am J Forensic Med Pathol* 1992; **13**: 346–50.
- 34 Teesson M, Ross J, Darke S, et al. One year outcomes for heroin dependence: findings from the Australian Treatment Outcome Study (ATOS). *Drug Alcohol Depend* 2006; **83**: 174–80.
- 35 McLellan AT. Have we evaluated addiction treatment correctly? Implications from a chronic care perspective. *Addiction* 2002; **97**: 249–52.