

## The Drug Treatment Outcomes Research study (DTORS): Cost-effectiveness analysis

*Linda Davies, Andrew Jones, Georgios Vamvakas, Richard Dubourg and Michael Donmall*

The Drug Treatment Outcomes Research Study (DTORS) assessed the outcomes, costs and benefits of drug treatment in England.

Results obtained in the study were variable and affected by a very small number of outliers. However, they provided evidence that treatment was effective in improving health status and in reducing the costs of other health and social care services. Overall, the net benefits of structured drug treatment were estimated to be positive, both overall and at the individual level in around 80 per cent of cases, with a benefit-cost ratio of approximately 2.5:1. Small sample size prevented the estimation of robust net benefits for sample subgroups. However, the results are broadly generalisable to the population of people seeking structured drug treatment in England and Wales.

There were limitations to the analysis, due to missing observations and follow-up data, and the use of self-report data to estimate service use, offending and health status. The absence of a control group not receiving treatment also means that it is not possible to ascribe with a high degree of confidence any observed changes in outcomes to structured drug treatment specifically.

DTORS participants were individuals who had received triage and a care plan for drug treatment, and not all of these would have taken up or completed their courses of treatment. The reported results reflect the average over all individuals. Further, the analysis does not include the costs of ancillary services which might have been received prior to accessing treatment, for instance the costs of triage and care plans. More significantly, the costs of referral through schemes such as the Drug Interventions Programme are also excluded

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### Keywords

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### Context

The National Treatment Outcomes Research Study (NTORS) concluded that drug treatment could be effective and cost-beneficial for drug users in England. Since the time of NTORS in the 1990s, there have been significant changes in the context of drug use and treatment in England. For example, the use of crack or cocaine has risen significantly. Concurrently, increasing use of referral into treatment via the criminal justice system (CJS) has increased the proportion of individuals seeking treatment who are drug-misusing offenders, who tend to have more serious drug problems, which are potentially less responsive to treatment. New evidence is therefore needed about whether services are effective and an efficient use of resources. The aim of this study was to assess, as part of the Drug Treatment Outcomes Research Study (DTORS), the cost-effectiveness of services for people requiring structured (Tier 3 and 4) drug treatment, which comprises inpatient drug treatment, specialist and GP prescribing, counselling, structured day programmes, residential rehabilitation, structured alcohol interventions and other structured interventions.

### Approach

The participants in this economic analysis were the adult treatment seekers who participated in baseline interviews for the DTORS and had an assessment for structured drug treatment. The costs of structured drug treatment services were collected from the National Drug Treatment Monitoring System (NDTMS). All other costs and outcomes were estimated from data collected in the DTORS interviews. The baseline interviews for DTORS took place after initial assessment for treatment. Follow-up interviews were conducted at between three to five months after the baseline interview and then again between 11 to 13 months after the initial interview. The data were weighted to be representative of adult treatment seekers in England

and to account for non-response bias in follow-up data. The analysis estimated the costs and benefits of structured drug treatment from baseline to the end of scheduled follow-up (one year), for all participants, including those who did not complete treatment. A comparison set of costs and quality-adjusted life years (QALYs) of no drug treatment was estimated to represent what the costs and QALYs of DTORS participants might be if they did not start drug treatment. This was based on an extrapolation of the baseline results covering the four weeks prior to the first interview. The costs and QALYs of structured drug treatment from baseline to end of follow-up were then compared to the expected costs and QALYs of no drug treatment. Using simulation techniques, the analysis estimated the likelihood that the net benefits gained by individuals following structured drug treatment were positive. Missing data were imputed using the technique of multiple imputation. Baseline covariates were included in the analyses to control for the effect of differences in the characteristics of the participants and the drug treatment services. The analysis used a generalised linear regression model to analyse the imputed cost and QALY data, using the baseline survey weights.

### Results

The average cost of drug treatment over the whole DTORS sample was estimated to be £6,064 (standard error (se) £398; sample size n=1,545) from baseline to the end of scheduled follow-up, with higher average costs after the first follow-up than before. The use of health and social care services, accommodation and the number of participants who had children in care was relatively low. The number of participants who reported committing offences decreased between baseline and follow-up. However, the estimated mean costs of offences were very variable and all had very high standard deviations. The estimated total costs of service use and offending were £26,988 (se £10,452; n=459) per person between baseline and second follow-up.

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The costs of structured drug treatment were compared with a constructed counterfactual group representing what might have happened in the absence of structured drug treatment. After controlling for baseline covariates and imputing missing data, the net cost of structured drug treatment was £4,531 (se £351). This was offset by savings in other health and social care service use and reported offences to give an overall net saving of £6,450 (se £6,779). Structured drug treatment was associated with higher QALYs. Valuing this gain at £30,000 per QALY, there is a total net benefit associated with structured drug treatment of £6,527 (se £67). This implies a benefit-cost ratio of approximately 2.5:1. Bootstrap techniques were used to estimate the probability that structured drug treatment is cost-beneficial overall. This result suggests that, across the relevant range of possible values for gaining one QALY in people who seek and use structured drug treatment, structured drug treatment has around an 80 per cent chance of being cost-beneficial at the individual level.

## Conclusions and implications

Combining the costs and outcomes, the analysis suggests a positive mean net benefit from structured treatment. The probability that structured drug treatment is cost-effective is around 80 per cent (based on the relevant range of possible values of a QALY). This suggests that gains from treatment of the majority of individuals are not outweighed by losses incurred by treatment of the remainder.

DTORS participants were individuals who had received triage and a care plan for drug treatment. Not all of these individuals actually took up or completed the treatment offered to them. One might, therefore, expect both benefits and costs to be higher for those who actually do receive treatment compared with those who do not, although this is not guaranteed. The final sample size of DTORS participants was not sufficiently large to estimate net benefits only for those who did consume treatment services.

Further, the analysis does not include the costs of ancillary services which might have been received prior to accessing treatment. For instance, the costs of referral through schemes such as the Drug Interventions Programme are excluded. This means that the estimated net benefits of treatment are not necessarily indicative of the overall net benefits of drug treatment *referral*.

Key strengths of the analysis are, first, that the economic data were collected as part of the DTORS so the results of the economic analysis are broadly generalisable to the population of people seeking structured drug treatment in England. Second, detailed Tier 3 and 4 drug treatment data were collected for 86 per cent of the DTORS participants from the NDTMS, for the 12 months of scheduled follow-up. Third, the analysis used a broadly societal perspective which means that the net savings found in this study are broadly representative of the benefits to society. Fourth, the economic analysis uses QALYs to measure the value of any improvements in health to drug users and directly incorporates the benefits of structured drug treatment to drug users.

However, there are significant qualifications to the study results which need to be borne in mind. First, the study and results are dependent on the validity of self-reported levels of offending and use of social services. Second, there was a high rate of missing follow-up and observations in the DTORS. Only 326 or 18 per cent of DTORS participants had complete records of service use and offences. Sample survey weights and multiple imputation were used to control for the impact of missing follow-up and missing data. Third, although the study included some costs which were not considered in the earlier NTORS study, some costs were excluded. Fourth, the unit cost data used to estimate costs of treatment, health and social care and offences may be subject to variation and uncertainty. Fifth, and most importantly, it was not feasible to include a control or comparator group that did not receive structured drug treatment in the design of the DTORS. To assess the cost-effectiveness of structured drug treatment, a comparison group was constructed that represented what might happen in the absence of structured drug treatment. This assumes that the costs and effects observed at the baseline interview would have remained constant over the follow-up period. The absence of a control group means that it is not possible to ascribe any observed changes in outcomes to drug treatment specifically with high confidence. As such, the results are best seen as suggestive of possible benefits of treatment rather than indicative of causation.

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### I. Context

Drug treatment and rehabilitation services are commissioned and provided in four tiers. Tiers 1 and 2 provide: open access and non-structured drug treatment services; information, advice and harm reduction services; screening for drug misuse and referral to specialist drugs services. Tier 3 provides structured community-based drug treatment and rehabilitation services. Services in Tier 4 provide residential drug treatment and rehabilitation, aimed at individuals with a high level of presenting need. Tiers 3 and 4 services account for around 70 per cent of total drug treatment costs.

There is evidence that drug treatment is effective in reducing dependency on drugs and alcohol and the adverse consequences associated with drug misuse (Department of Health, 1996; Gossop et al., 2001; Gossop, 2006). The UK's largest study to date (the National Treatment Outcomes Research Study (NTORS)) concluded that drug treatment could be effective and cost-beneficial for drug users in England (Gossop et al., 1999; Godfrey et al., 2004). However, in the UK, the commissioning and delivery of drug treatment varies between localities and agencies (Millar et al., 2004; Hubbard et al., 1997; Simpson et al., 1997; Donmall et al., 2003; Millar et al., 2002; Millar et al., 2004), which means that the relative effectiveness and cost-effectiveness of drug treatment is also likely to vary.

Over the last ten years, the use of crack or cocaine nationally has risen from around 14 per cent of drug users at the time of the NTORS (in 1996) (Department of Health, 1998) to 44 per cent in 2006 (National Drug Treatment Monitoring Service (NDTMS), unpublished), and up to 73 per cent in individual Drug Action Teams (DATs). Treatment response for crack and cocaine users is varied and uncertain (Seivewright et al., 2000; Gossop et al., 2002). Concurrently, increasing use of diversionary schemes in the criminal justice system (CJS) has increased the proportion of drug-misusing offenders seeking

treatment. Offenders who misuse drugs have been found to have more serious drug problems, which are potentially less responsive to treatment (Oerton et al., 2003; Millar et al., 2002; Sondhi et al., 2002; Stewart et al., 2000; Millar et al., 2002). If clients complete treatment, it may be equally effective for clients of CJS and non-CJS referral sources (Hough, 1996; Millar et al., 2002). However, much of the evidence is generated from research in North America, and there are important differences between North American models of legal coercion based on inpatient and residential treatment and the UK CJS referral schemes that use Tier 3, community-based, service provision (Hubbard et al., 1997; Joe et al., 1998; Simpson et al., 1997; Desmond et al., 1996).

With substantial expenditure on drug treatment services, increases in the number and heterogeneity of drug users in contact with treatment facilities and changes in the process of treatment, new evidence is needed about whether services are effective and an efficient use of resources.

The aim of this study was to assess and compare the costs and benefits associated with drug treatment and rehabilitation services for people requiring structured services (Tiers 3 and 4). The costs included the costs of resources used to provide Tier 3 and 4 services. The benefits considered included reductions in the costs of other publicly provided health and social care services (such as childcare, accommodation and health care other than drug treatment) and reductions in the costs of offending behaviour (including the costs of criminal justice services and the costs to victims of physical and emotional or psychological harm). The benefits of improvements in participants' health were also included through the use of the Quality-Adjusted Life Year (QALY) measure, the standard health status measure used in health services resource analysis and research in England and Wales (Gold et al., 1996; NICE, 2004).

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Specific research questions considered in this study.

- What are the costs of drug treatment services and other health, social and criminal justice services used by participants?
  - What is the health status and associated utility (quality of life) of participants?
  - Are there trends in non-drug treatment costs and/or improvements in QALYs over the follow-up period?
  - Do savings in non-drug treatment costs and other benefits offset the costs of drug treatment?
  - What are the size and value of improvements in health status and associated QALYs?
- 

## 2. Methods

### The Drug Treatment Outcomes Research Study

This economic analysis was conducted as part of the Drug Treatment Outcomes Research Study (DTORS). The methods and results from the main DTORS about the effectiveness of treatment are described in detail elsewhere (Jones *et al.*, 2009; Jones *et al.*, 2007). Briefly, DTORS was a longitudinal study in 94 DATs in England. Participants were recruited from agencies that provided Tier 3 or Tier 4 services. All adults seeking a new episode of structured drug treatment for drug misuse (but not primary alcohol misuse) were eligible for the study. People who consented to participate in the study completed a baseline interview, with scheduled follow-up up to 12 months following entry into the study. The sample of participants differed in some characteristics from the population of treatment seekers. The respondents in the DTORS baseline sample and individuals with new episodes who are included in the NDTMS in the same period (March 2006 to January 2007 inclusive) differed in the following characteristics.

1. DTORS participants were on average one year older than the NDTMS sample, were under-represented in the 18 to 24 age group (14 per cent DTORS vs 20 per cent NDTMS) and over-represented in the other age groups.

2. More of the DTORS sample were referred to treatment by the criminal justice system (35 per cent) than the NDTMS sample (26 per cent). However, this difference may be distorted by the detailed questions asked of the participants in the DTORS survey to describe the route taken to treatment.
3. The DTORS sample differed from the NDTMS sample of new episodes in reporting crack cocaine as the main problem drug (13 per cent DTORS vs eight per cent NDTMS). Other differences exist such as the lower level of cocaine (three per cent DTORS vs eight per cent NDTMS) and cannabis (four per cent DTORS vs nine per cent NDTMS) reported as the main problem drug.

To account for this, the baseline data were weighted by these characteristics, so that the data were more representative of the population of adult drug treatment seekers in England. Not all participants completed follow-up interviews, whilst some participants completed two follow-up interviews within the scheduled 12-month follow-up period (Jones *et al.*, 2008). Follow-up interviews were planned at between three and five months and 11 and 13 months following the baseline interview. Of those recruited at baseline, 1,131 (63 per cent) were interviewed again. The majority of initial follow-up interviews were conducted between three to five months after the baseline interview (n=886). A further 245 initial interviews were achieved outside this three- to five-month window and up to 12 months after the baseline interview. Of the 886 followed up within three to five months, 504 were interviewed for a third time, between 11 and 13 months after their baseline interview; these are referred to as second follow-up. To minimise the impact of participants being lost to follow-up, follow-up data were also weighted. The follow-up data were weighted by the characteristics of follow-up responders and non-responders to account for differences between these two groups of individuals.

### Economic framework

The economic approach estimated the costs and benefits of drug treatment from baseline to the end of scheduled follow-up (one year). Full details of the methods are provided in the technical report (Davies *et al.*, 2009).

These estimates of the costs and benefits of drug treatment included the costs of Tier 3 and 4 drug treatment services, the costs of health care, accommodation, children in care, criminal activities, and

quality of life (measured in terms of QALYs). The costs and QALYs were estimated from the actual use of Tier 3 and Tier 4 drug treatment services recorded in the National Drug Treatment Monitoring System and data reported by the DTORS participants at the baseline, first and second follow-up interviews. The costs and QALYs were estimated for all participants who had a triage assessment and plan for structured drug treatment whether or not they started or completed that structured drug treatment. This is referred to as structured drug treatment in this report and the accompanying technical report (Davies *et al.*, 2009).

Details of unit costs used in the analysis to translate resource use, offending behaviour and quality of life measures into money values are presented below.

To estimate the benefits of drug treatment, it is necessary to compare against what would have happened in the absence of any treatment occurring. By design, longitudinal studies such as DTORS do not include an independent control group of participants against which outcomes can be compared. Therefore, a comparison set of the annual costs and QALYs expected to be associated with no drug treatment was

estimated on the basis of activities reported by participants at baseline interview prior to the commencement of treatment. These were taken to represent what the costs and QALYs of DTORS participants would have been if they had not been assessed for or started Tier 3 or 4 drug treatment. It was, therefore, assumed that the baseline estimates and outcomes would stay constant in the absence of drug treatment. This comparison group is referred to as the no treatment or no drug treatment group in this report and the accompanying technical report (Davies *et al.*, 2009).

## Cost estimation

The costs of drug treatment and other services used by DTORS participants, and the costs of offending behaviour, were estimated as the product of the quantity (of services used or offences committed) and average unit cost (of the service or offence). All the cost figures presented are estimates and statistically control for sample characteristics and baseline covariates (described in more detail in the data analysis section), so include some level of uncertainty. The terms costs and cost estimates are used interchangeably.

**Table 1** Types and sources of data

Type of data	Sample/unit	Unit/measure	Source
Tier 3 and 4 drug treatment services	DTORS	Participant follow-up	NDTMS
Use of other health care services	DTORS	Baseline, and follow-up interviews	DTORS survey
Accommodation	DTORS	“	DTORS survey
Children in care	DTORS	“	DTORS survey
Offending behaviour	DTORS	“	DTORS survey
Number of weeks follow-up	DTORS	“	DTORS survey
Unit costs of Tier 3 and 4 drug treatment	Drug users	Per unit of service use	NTA*
Unit costs of children in care	Various	Per week	Curtis 2007
Unit costs of accommodation	Various	Per night	Curtis 2007
Unit costs of offending behaviour	Various	Per offence	Dubourg <i>et al.</i> , 2005; Home Office
General Practitioner services	Various	Per minute of visit	Curtis 2007
Community nurse, social worker and other professional services	Various	Per hour of client contact	Curtis 2007
Psychiatry, alcohol, non-psychiatric	Various	Per hospital outpatient visit	Curtis 2007
Accident and emergency	Various	Per visit	Curtis 2007
Day hospital	Various	Per hospital day visit	Curtis 2007
Psychiatric services	Various	Per inpatient day	Curtis 2007
General medical and surgical, and other services	Various	“	Curtis 2007
Other unstructured drug treatment services**	Various	Per episode	NDTMS and NTA

\* The unit costs of drug treatment services were estimated from a drug treatment cost database developed by the National Treatment Agency, based on actual expenditure and utilisation of drug treatment services.

\*\* Needle exchange service, prevention of overdose advice, safer injecting advice.

The unit costs of services were estimated from the perspective of service providers and commissioners. The unit costs of offences have been estimated previously by the Home Office, and include costs to the criminal justice system, victims of crime (actual and potential), other public services such as health and social care used by the victims, and other organisations which bear the costs of victimisation (e.g. employers) (Brand and Price, 2000; Dubourg *et al.*, 2005).

The methods used to cost each category of service varied according to the way in which the service use data were collected and the source of the unit cost data. All costs with a price year other than 2006/07 (e.g. the NTA database and the NHS reference costs 2005/06) were standardised to a single price year, 2006/07, using an inflation rate of 4.6 per cent, derived from the health services price indices reported by Curtis (2007).

The sources of volume and unit cost data are summarised in Table 1. Full details of the costing methods and the unit costs used are provided in the methods section of the technical report (Davies *et al.*, 2009).

### **Cost of Tier 3 and 4 drug treatment services**

The quantity and costs of Tier 3 and 4 drug treatment services used were based on the National Drug Treatment Monitoring System database, and included inpatient drug treatment, specialist and GP prescribing, counselling, structured day programmes, residential rehabilitation, structured alcohol interventions and other structured interventions. The costs were derived from the NDTMS database for all DTORS participants who completed a baseline survey and had an NDTMS record. Complete treatment data were available for these participants, even if they did not complete follow-up DTORS survey interviews.

### **Cost of health care**

The quantities received of health and social care services other than for Tier 3 and 4 drug treatment were estimated from the DTORS survey. Participants were asked not to include the use of formal drug treatment services in their reported service use. At the baseline interview, participants were asked whether they had used any health care for psychiatric or mental health care needs in the last three months. At the first and second follow-up interviews, respondents were asked about whether they had used hospital inpatient, outpatient and community-based health care services since their last interview and how much they had used those services. These services were valued using the costs produced by Curtis (2007).

### **Cost of accommodation**

The DTORS survey asked respondents which types of accommodation they had used in the last month, and which type of accommodation they had spent most nights in. This included whether the participant had lived in his/her own accommodation, with family or friends, stayed in a squat or slept rough. These types of accommodation were costed at zero. It was assumed that these forms of accommodation did not incur an additional cost to society as a result of structured drug treatment. The use of overnight stays in hospital or other medical establishments for structured drug treatment or other health care and overnight stays in prison or custody were also asked about. These forms of overnight accommodation were not included here as costs of accommodation, as they are included in the costs of health care, drug treatment and offending behaviour (see relevant sections). The additional costs of overnight accommodation in residential services such as hostels and shelters, which were assumed to be an additional use of resources, were estimated on the basis of the DTORS survey responses (services received) and unit costs.

### **Cost of childcare**

The costs of childcare were estimated for participants who had children who were looked after or in formal care funded by local authorities. The costs were estimated from data collected in the DTORS survey and published unit costs. The costs of education, health care and other services used by children whether they are in formal care or not were excluded, as these were not likely to be affected by whether a participant received drug treatment or not.

### **Costs of offences**

The DTORS survey included questions about the types and volumes of offending behaviours participants reported having committed, in the previous four weeks, at baseline and each follow-up interview. It was assumed that offences committed in the previous four weeks were representative of behaviour for the period between interviews. Each offence was costed using unit cost data provided by the Home Office (Brand and Price, 2000; Dubourg *et al.*, 2005). Although data were collected about levels of begging, prostitution, buying and selling of stolen goods and drug dealing, unit costs were not available for these offences, so they were excluded from the economic analysis. However, the costs of these offences are unlikely to be high relative to other offences due to their victimless nature, so this exclusion is unlikely to affect the results significantly. If drug treatment reduces the levels of these offences, then excluding them from the analysis will underestimate any savings or cost offsets due to drug treatment.

## Estimation of utilities and quality adjusted life years

The DTORS survey included a validated self-report measure of health status, which asked questions about the current health of the participant using the short form 12 (SF12) survey instrument (Ware, Kosinski, and Keller, 1996). The measure includes assessment of physical function, limitations in role due to physical or emotional problems, the effect of pain on normal work and activities, general health, vitality, impact of physical or emotional problems on social activities, and mental health. The responses to the questions were aggregated into a composite measure of health-related quality of life using a set of pre-defined utility weights constructed by Brazier *et al.* (2004). These utility weights were derived from a sample of the general population and measure the relative value (or utility) of each aspect of health to the respondents (Brazier *et al.*, 2004). It was assumed that any change in utility between interviews would take place halfway through the time period. Accordingly, QALYs for each individual were estimated as 50 per cent of the utility weight at one interview plus 50 per cent of the utility weight at the subsequent interview, multiplied by the time between interviews.

## Estimation of net cost or net benefit

The net costs or savings of structured drug treatment were estimated as the difference in the total costs of drug treatment, health and social care and offences estimated for the treatment group and the expected costs estimated for the hypothetical comparison or counterfactual group. This requires that health gains measured in terms of increased QALYs be valued in monetary terms. However, in the UK there is no universally agreed value of a QALY. An approach used in health care is then to ask the question: what is the maximum amount decision makers are willing to pay to gain one QALY? An analysis of decisions made by the National Institute for Clinical Excellence (NICE) suggests a range of implicit values between £15,000 and £30,000 (Rawlins and Culyer, 2004). For this work, therefore, QALYs were valued at £30,000, with sensitivity analysis presented on the basis of a range of different values from £1 to £50,000 to gain one QALY in structured drug treatment seekers. The difference in the monetised value of the QALY between the treatment and comparison groups was then added to the net costs to calculate the overall net cost or net benefit of structured drug treatment.

## Outliers

Some participants (seven at baseline interview, two at first follow-up interview and three at second follow-up interview) in the DTORS survey reported levels of offending which were so high as to be judged unreliable. This judgement was based on comparison with a number of sources of evidence on offending levels, including the Arrestee Survey (Boreham *et al.*, 2006). These cases were excluded from the main analysis. Extreme rates of service use or cost were not found in other cost categories and no other data were excluded.

## Sample weights

Not all drug treatment seekers had an equal chance of being included in the study, and some agencies and eligible treatment seekers refused to participate. This means that the DTORS sample was not representative of the target population of treatment seekers. Baseline sample weights were calculated to adjust the DTORS sample to be more representative (Jones *et al.*, 2007). This increases the relevance of the results and conclusions about treatment practice and policy to all treatment seekers for Tier 3 and 4 services. Additional weights were estimated to control for differences between the DTORS participants who had follow-up interviews and those who did not. These same baseline and follow-up weights were used in the economic analyses.

## Missing data

A proportion of the DTORS participants had missing data. This was for three reasons.

1. Not all participants had a follow-up interview (e.g. due to difficulties in contacting them), so follow-up data could not be collected in the DTORS survey.
2. Not all participants in the DTORS survey could be matched to the NDTMS, so information on their use of Tier 3 and 4 drug treatment services was not available.
3. Some participants who completed the DTORS survey interviews and were matched to the NDTMS had incomplete data. This could be because they did not provide responses to all the questions in the survey or there were missing observations about treatment data on the NDTMS.

**Table 2** Characteristics of the DTORS survey participants

Characteristic		n	%
Number of participants included		1,793	100
Which interviews attended	Baseline	1,794	100
	Baseline and 1st	1,131	63
	Baseline, 1st and 2nd	504	28
Primary problem drug at baseline	Other drugs	446	23
	Heroin	1,293	66
	Crack	233	12
Received drug treatment before	No	572	29
	Yes	1,401	71
Did the participant start drug treatment (from NDTMS and DTORS survey data)	Triage only	122	8
	Triage and treatment	1,451	92
Gender	Male	1,429	72
	Female	544	28
Referral source	Non-CJS	1,332	68
	CJS	641	32
Taken less drugs in 4 weeks before baseline	No	1,278	65
	Yes	695	35
Injected in the last 4 weeks at baseline	No	1,292	65
	Yes	681	35
Have used heroin at baseline	No	716	36
	Yes	1,257	64
Have used crack at baseline	No	1,124	57
	Yes	849	43
Have offended in last 4 weeks at baseline	No	1,123	57
	Yes	850	43
Ethnic group	White	1,785	90
	Not White	188	10
Severity of dependence on drugs	None or no relevant drugs	382	19
	Low	256	13
	Medium	694	35
	High	640	32
Motivation to change	1st quartile	452	23
	2nd quartile	554	28
	3rd quartile	503	26
	4th quartile	463	23
Restricted	No	1,516	77
	Yes	457	23

Any differences between the participants who had follow-up interviews or complete NDTMS data and those who did not could bias the estimated service use, costs and benefits associated with Tier 3 and 4 drug treatment. Therefore, multiple imputation (Briggs *et al.*, 2003) was used to impute missing cost and QALY data over the scheduled one-year follow-up period. Multiple imputation methods use multivariate analysis to predict the values of missing data for each participant. If the missing data are statistically associated with, or depend on, other observed variables in the data

set (for example, social and demographic characteristics, treatment centre or DAT, and the use of crack or heroin), then the missing data may be treated as if they are missing at random. This holds as long as the missing data do not also depend on factors that have not been observed or measured in the datasets (Briggs *et al.*, 2003). However, other methods of dealing with missing data might be more appropriate if the missing data do depend on unobserved variables. It is not clear that any method of imputation or controlling for missing data is adequate if there are high levels of missing data.

The multiple imputation approach includes a random element to reflect the fact that the predicted or imputed values are estimated and therefore uncertain. A fuller description of the process is given in the technical report (Davies *et al.*, 2009).

the analyses were run in the software package Stata version 9. The technical report (Davies *et al.*, 2009) gives more detail on the models and analytic techniques used.

## Data analysis

The baseline and survey sample weights were used in all analyses to adjust for differences between the sample and target population and any biases introduced by incomplete follow-up. The analyses of costs and QALYs are presented with and without the inclusion of a standard set of baseline covariates to control for the effect of differences in the characteristics of the participants and the drug treatment services. A standard set of covariates were selected a priori for the main DTORS survey analysis. The covariates were included to reduce any potential bias caused by variation between participants. A list of the standard set of covariates is given in the technical report (Davies *et al.*, 2009).

A generalised linear regression model was used to analyse the imputed cost and QALY data, using the baseline survey weights and the standard set of covariates. The model included an additional categorical variable to represent drug treatment or no drug treatment. The estimates of cost and QALY from the regression were then simulated to represent the sample distribution and variance in the costs and QALY (Briggs *et al.*, 2003). Ten thousand pairs of estimates of the net cost and net QALY of Tier 3 and 4 drug treatment were simulated. These simulated data were then used for the economic analysis to estimate the probability that structured drug treatment was cost-saving and led to improvements in health, compared with non-structured drug treatment. All of

## 3. Results

### Participants

The DTORS survey included 1,794 participants with complete usable responses from the baseline interview. Of these, 1,131 (63 per cent) were included in the first follow-up and 504 (28 per cent) in the second follow-up. Data on the use of Tier 3 and 4 drug treatment services from the NDTMS were available for 1,573 (88 per cent) of the participants who completed a baseline interview in the DTORS survey. Of these, 1,545 (86 per cent) had sufficient data to estimate treatment costs between the baseline and the end of the follow-up period. Table 2 includes a summary of the key characteristics of the survey participants that were included in the economic analyses. Full details about the participants in the DTORS survey are given in the baseline report and appendices (Jones *et al.*, 2009). The average number of weeks between the baseline interview and the first follow-up was 19 (standard deviation (sd) 10, range 9-59, n=1,131). The average number of weeks between the first and second follow-up interviews was 36 (sd 4, range 27-47, n=504). The average number of weeks between the baseline and second follow-up interview was 51 (sd 3, range 44-62, n=504).

**Table 3 Use and cost of Tier 3 and 4 drug treatment services**

Type of service	Users	Days		Cost/day	Estimated total cost	
		mean	se			se
Triage assessment	1,571	na	na	na	£653,225	£79,801
Inpatient treatment	283	38	7	£153	£1,650,278	£457,232
Specialist prescribing	836	202	8	£15	£2,336,182	£327,664
GP prescribing	276	183	10	£3	£135,987	£20,920
Counselling	390	144	7	£7	£414,300	£55,075
Structured day care	433	135	9	£20	£1,196,269	£176,250
Residential rehabilitation	261	127	10	£47	£1,743,462	£380,690
Aftercare	48	135	15	£19	£118,298	£29,936
Structured alcohol care	28	99	26	£18	£53,411	£19,031
Other structured care	430	154	7	£16	£1,027,719	£133,040
Total cost					£9,329,131	£1,271,046

## Costs of Tier 3 and 4 drug treatment services

The use of structured (Tier 3 or 4) drug treatment by participants in the DTORS survey is described in the final report (Jones *et al.*, 2009). Table 3 summarises the use of services reported in the NDTMS database for those DTORS participants who had NDTMS records. The results relate to participants with complete treatment cost data, weighted by the sample weights calculated for the main survey. They are therefore estimated to reflect the characteristics of the population of drug users as a whole. Table 3 shows the average use of each service for those people who used that particular service, and the estimated total cost of use of each service.

Overall, the participants used an average of 1.4 types of treatment each (range 0-6, sd 0.9). Specialist prescribing services were the most used Tier 3/4 service (37 per cent of participants, weighted by main survey sample weights), and also represented the largest single class of cost (£2.3m). Structured day care (19 per cent) and other structured interventions (17 per cent) were the next most used services. Inpatient treatment and residential rehabilitation were each used by 15 per cent of participants but were the second and third largest classes of cost due to their high unit cost (both just under £6,000). Only 11 per cent used GP prescribing. The use and costs of needle exchange and drug-related advice services are not provided as Tier 3 or 4 structured drug treatment services, so are not routinely recorded in the NDTMS for all participants. The DTORS participants did also use these types of service, and the costs of these are presented in Table 4.

Table 4 summarises the overall use and estimated cost per person of drug treatment services used within one year of the baseline interview (for the whole sample of DTORS participants who completed the baseline interview and had NDTMS treatment records). The costs were derived from the NDTMS database for all DTORS participants with a complete NDTMS record. Means and standard errors were estimated using survey sample weights. A detailed breakdown by type of service is given in the technical report (Tables 10 to 11; Davies *et al.*, 2009). The average cost of drug treatment over the whole DTORS sample was estimated to be £6,064 from baseline to the end of scheduled follow-up. The average cost of drug treatment per week was £144 (se £12) between baseline and first follow-up. This reduced to £67 (se £7) per person per week between first and second follow-up. The average cost per week overall was £97 (se £7) from baseline to second follow-up. A small proportion of people only had an

assessment and did not go on to use the structured drug treatment services captured in the NDTMS.

**Table 4** Use and estimated cost of Tier 3 and 4 drug treatment services, £s, 2006/07

	1st follow-up	2nd follow-up
Total sample, n=	1,545	1,545
Number of people using service (%)	1,269 (82)	1,076 (70)
Estimated mean cost (se) per person		
Since last interview	2,862 (218)	3,201 (203)
Baseline to second follow-up	na	6,064 (398)

## Costs of health and social care services and offending behaviour

Offending behaviour and the use of health and social care services (excluding Tier 3 and 4 drug treatment services) by participants in the DTORS survey are described in more detail in the final report of the DTORS survey results (Jones *et al.*, 2009). The costs of these services and offending behaviour are summarised below. Detailed cost data are presented in the technical report (Davies *et al.*, 2009, Tables 13 to 19). Cost estimates are based on responses to the DTORS survey, and relate to DTORS participants with complete follow-up data, weighted by the baseline and follow-up sample weights. The survey sample who completed the follow-up interviews is a subset of the sample who completed the baseline interviews (n=1,794) and for whom complete NDTMS Tier 3 and 4 treatment service data were available (n=1,545).

### Costs of health care services

The top half of Table 5 summarises the number of DTORS participants who reported using health care services other than structured drug treatment services, needle exchange and drugs advice prior to the baseline and since their last interview. The use and costs of non-structured drug treatment services (needle exchange and drug-related advice) were estimated from DTORS survey data and are presented in the bottom half of Table 5. The use and costs of structured drug treatment services were estimated from the NDTMS rather than DTORS data and are presented in Tables 3 and 4. Table 4 also includes the estimated average cost per person for these services, for the time since their last interview and for the previous four weeks (based on their calculated average cost per week). Means and linearised standard errors were estimated using survey sample weights. The technical report (Davies *et al.*, 2009, Tables 13 to 14) gives detailed information about the use of these health and social care services.

**Table 5 Use and estimated costs of health and social care services, £s, 2006/07**

	Baseline	1st follow-up	2nd follow-up
<b>Used any service prior to interview*</b>			
Total sample n	1,775	928	503
Number of people using service (%)	na	171 (18)	66 (13)
<b>Estimated mean cost (se) per person</b>			
Previous four weeks	20 (1)**	8 (3)	7 (1)
Since last interview	na	208 (83)	438 (71)
Baseline to second follow-up	na	na	643 (123)
<b>Used any needle exchange or drug-related advice service since last interview</b>			
n	1,791	1,127	504
Number (%)	1,252 (70)	464 (41)	161 (32)
<b>Estimated mean cost (se) per person</b>			
Previous four weeks	4 (0.2)	3 (0.2)	3 (0.2)
Since last interview	na	61 (5)	53 (5)
Baseline to second follow-up	na	na	117 (8)

\* Excludes the cost of needle exchange and drug-related advice services.

\*\* Imputed costs, see Appendix I for details on imputation method for this variable

Relatively few people reported using any health and social care services at first and second follow-up and this is reflected in the low cost per person of £643 from baseline to the end of follow-up. The average cost per person who actually used health and social care services and reported full follow-up observations was £2,184 (sd 390, n=129), ranging from a minimum of £26 for a person who used primary and community care services to £45,000 for a person who was admitted to hospital.

A high proportion (70 per cent) of people at baseline used needle exchange and drug-related advice services, falling to 32 per cent at the second follow-up period. The average cost per person of these services was low and fell between the baseline and second follow-up interviews.

### Costs of accommodation

Table 6 presents information on the use and estimated costs of formal accommodation obtained from DTORS survey responses. As before, means and linearised standard errors were estimated using survey sample weights. Less than a third of people had stayed in a residential hostel or night-time drop-in centre for one night or more in the four weeks prior to the baseline interview. This decreased to less than a fifth by the time of the second interview. The average cost per person who actually used this type of accommodation was £7,020 (sd 876, n= 59) and ranged from a minimum of £114 for someone who used hostel or night-time drop-in centres on an occasional basis to a maximum of £33,178 for someone who lived in this type of accommodation most or all of the time. (See Davies *et al.* (2009) Tables 15 to 16 for more detail.) The estimated average total cost from baseline to second follow-up was £1,045 per person overall.

**Table 6 Use and estimated costs of formal accommodation, £s, 2006/07**

	Baseline	1st follow-up	2nd follow-up
<b>Used formal accommodation in previous four weeks</b>			
Total sample, n=	1,787	1,118	500
Number of people using service (%)	256 (14)	136 (12)	40 (8)
<b>Estimated mean cost (se) per person</b>			
Previous four weeks	122 (13)	120 (13)	68 (15)
Since last interview	na	558 (72)	591 (127)
Baseline to second follow-up	na	na	1,045 (182)

**Table 7 Use and estimated costs of formal social childcare services, £s, 2006/07**

	Baseline	1st follow-up	2nd follow-up
Had children in care in previous four weeks			
Total sample n	1,791	1,081	497
Number of people using service (%)	72 (4)	43 (4)	20 (4)
Estimated mean cost (se) per person			
Previous four weeks	227 (40)	174 (45)	131 (46)
Since last interview	na	762 (173)	633 (199)
Baseline to second follow-up	na	na	1,095 (372)

**Costs of children in care**

Table 7 reports the number of people who had children in formal care at any time during the survey period, and the estimated costs of these services. As before, means and linearised standard errors were estimated using survey sample weights, with costs based on reported duration of service use. Only four per cent of the total sample of participants had children in care at each of the follow-up points. The average costs per person who had one or more children in care was £35,123 (sd £7,610, n=16). This ranged from a minimum of £4,368 for someone whose child was in care for a relatively short time to a maximum of £116,480 for someone with five children in care for the full follow-up period. The estimated average cost per person overall fell between baseline and follow-up, and amounted to £1,095 over the entire survey period.

**Costs of offending behaviour**

Table 8 shows the reported number of offences committed by survey participants in the four weeks prior to interview. The average number of offences fell between baseline and the end of follow-up, but rose between first and second follow-up. Shoplifting, buying and selling stolen goods and drug dealing comprise by far the largest proportion of the total, and rise over the follow-up period (from 80 per cent at baseline to over 90 per cent at second follow-up).

Table 9 shows the estimated costs of these offences. (See Davies *et al.* (2009) Tables 18 to 19 for more detail.) The average cost per person of offending in the four weeks prior to interview declined between baseline and first follow-up, then rose between first

**Table 8 Reported offences in the previous four weeks, £s, 2006/07**

Offence type	Number of reported offences								
	Baseline			1st follow-up			2nd follow-up		
	n	Mean	se	n	Mean	se	n	Mean	se
Shoplifting	1,754	3.71	0.59	1,064	1.63	0.68	479	3.46	2.6
Begging	1,772	0.47	0.08	1,067	0.27	0.1	483	0.15	0.07
Buying and selling stolen goods	1,749	2.43	0.42	1,066	1.79	1.11	482	0.63	0.19
Drug dealing	1,761	2.13	0.5	1,067	2.28	1.27	481	4.52	2.99
Prostitution	1,772	0.49	0.22	1,070	0.09	0.04	480	0.02	0.01
Theft of vehicle	1,769	0.05	0.01	1,070	0.02	0.01	482	0.02	0.01
Theft from vehicle	1,768	0.15	0.02	1,068	0.05	0.02	483	0.01	0.01
House burglary	1,771	0.03	0.01	1,067	0.02	0.01	482	0	0
Business burglary	1,768	0.19	0.04	1,069	0.08	0.02	483	0.17	0.11
Violent theft	1,770	0.06	0.02	1,070	0	0	482	0.01	0.01
Bag snatch	1,772	0.07	0.02	1,071	0.02	0.01	481	0.03	0.02
Other stealing	1,768	0.38	0.06	1,067	0.21	0.05	481	0.23	0.11
Cheque or credit card fraud	1,771	0.08	0.03	1,070	0.01	0	483	0.01	0.01
Benefit fraud	1,776	N.M.	N.M.	1,068	N.M.	N.M.	483	N.M.	N.M.
Other violent crime	1,772	0.11	0.01	1,070	0.08	0.02	483	0.09	0.04
Total		10.35			6.55			9.35	

and second follow-up. However, the estimated mean costs of offences all have very high standard deviations (estimated using survey sample weights), reflecting two things. First, the majority of people reported committing no offences in that time and so had no costs for offending behaviour. Second, there was substantial variation in the number and type of offences committed (and hence cost) by those who did offend. The cost per person of offences between baseline and second follow-up, for those people who did report offences, calculated on the basis of extrapolation of four-week offending, was £74,455 (sd £27,307, n=170). This ranged from £318, for someone who reported committing one offence of shoplifting in the four weeks prior to his/her first follow-up interview but no further offending, to £1.2 million, for someone who reported numerous offences of shop-lifting, business burglary and bag snatch in the four weeks prior to his/her second follow-up interview. This translates into an estimated average offending cost per person (including non-offenders) of £27,219 over the entire follow-up period.

These figures exclude the costs of 17 outlying cases who reported over 900 offences such as shoplifting or drug dealing or 30 more serious offences such as violent theft in the previous four weeks. Despite this, it can be seen from Table 9 that the estimated costs of offending are extremely variable and subject to some uncertainty. Extrapolating costs estimated on the basis of reported offending over four weeks to cover a period closer to one year has the advantage of reducing respondents' inability to recall their offending accurately over a longer time period, but at the expense of making them more susceptible to short-run variability. The small numbers of individuals reporting offending also increases the potential for variability. The period between baseline and first follow-up was also on average over 50 per cent shorter than that between first and second follow-up. All of these factors could explain, at least partly, the differences in the costs of offences for the previous four weeks reported at first and second follow-up interviews. This level of variability and uncertainty might be expected to have a large impact upon the results of any value-for-money assessment and the ability of the research design to detect a significant difference in outcomes.

**Table 9** *Reported offending and estimated costs of offences, £s, 2006/07*

	Baseline	1st follow-up	2nd follow-up
Reported offending in previous four weeks			
Total sample, n =	1,698	1,132	470
Number of people offending (%)	727 (41)	249 (22)	81 (16)
Estimated mean cost (se) per person			
Previous four weeks	3,341 (442)	1,474 (273)	2,519 (956)
Since last interview	na	8,494 (2,467)	23,533 (9,118)
Baseline to second follow-up	na	na	27,219 (10,305)

**Table 10** *Estimated cost of health and social care services and offences, £s, 2006/07*

	Baseline	1st follow-up	2nd follow-up
Total cost including offending			
Total sample, n =	1,694	805	459
Estimated mean cost (se) per person			
Previous four weeks	3,726 (443)	1,835 (356)	2,814 (1,000)
Since last interview	na 11,268	(3,330) 26,143	(9,440) (9,118)
Baseline to second follow-up	na	na	26,988 (10,452)
Total cost excluding offending			
Total sample, n =	1,765	871	492
Estimated mean cost (se) per person			
Previous four weeks	366 (44)	308 (53)	214 (56)
Since last interview	na	1,861 (285)	1,869 (294)
Baseline to second follow-up	na	na	3,056 (506)

### Total costs of health and social care services and reported offences

Table 10 summarises the estimated total costs of health and social care services and reported offences. Because offending costs are high and very variable, the total cost estimates are also reported without them to illustrate more clearly the impact of structured drug treatment on these other costs. The estimated costs for the four weeks prior to interview are lower at the first follow-up than baseline, but increase somewhat by the second follow-up. The costs presented in Table 10 are for the sample of participants who had complete data from which to estimate total costs. In contrast, the costs presented in Tables 4-9 are for the sample of participants for whom data was available for that component of cost. This means that summing the costs in Tables 4-9 will give different total costs from those presented in Table 10.

### Utility values and Quality-Adjusted Life Years

Table 11 shows the utility scores derived from responses obtained using the SF12 health status instrument, and the QALY values estimated from these scores. As with the cost data above, the results are the estimates for participants with complete utility data at each interview, weighted by the DTORS survey weights. Also as before, members of the survey sample who completed the SF12 questions at the follow-up interviews are a subset of the sample who completed the baseline interviews (n=1,794) and for whom NDTMS Tier 3 and 4 treatment service data were available (n=1,545). QALY values between interviews are estimated from the average of the SF12

scores at each interview multiplied by the time between interviews as a proportion of a full year. They therefore measure the quantity of quality-adjusted life experienced by respondents over the relevant survey period, and reflect both the estimated quality (as measured by SF12) and the time between interviews. Thus, respondents were estimated to have experienced a mean 0.68 QALYs over the average 51 week follow-up period, implying a quality of life relative to full health of approximately 0.69 over a full 12-month period.

### Costs and benefits of treatment

This section compares the costs and outcomes observed for DTORS participants with a constructed comparison group or counterfactual. The expected costs and outcomes for the comparison group were estimated by extrapolating the DTORS sample baseline costs of health and social care and offences and utility scores over the period of observed follow-up for each participant (an average of 51 weeks from baseline). Thus it was assumed that, in the absence of entering structured drug treatment, individuals' social care use, offending and health status would have remained unchanged for the follow-up period of 51 weeks.

The estimates of costs and QALYs for those people with complete follow-up and using multiple imputation to account for missing observations and using the combined sample and follow-up survey weights, are reported in Table 12. (The results of the complete case analysis and

**Table 11 Estimated utility and QALYs**

	Baseline	1st follow-up	2nd follow-up
n	1,762	1,121	500
Mean (se) SF12 score, previous four weeks	0.65 (0.005)	0.70 (0.006)	0.72 (0.007)
Mean (se) QALY score (se) since last interview	na	0.25 (0.008)	0.50 (0.006)
Mean (se) QALY score, baseline to second follow up	na	na	0.68 (0.007)

**Table 12 Costs and QALYs over 51-week period, with and without structured drug treatment, multiple imputation, weighted data, £s, 2006/07**

	Structured drug treatment, n=504		No drug treatment, n= 504	
	Mean	se	Mean	se
Cost of structured drug treatment	4,914	359	0	0
Cost of health and social care	3,120	800	4,543	1,623
Cost of reported offences	39,967	14,750	50,585	31,096
Total cost including offences	48,001	15,088	55,127	31,263
Total cost excluding offences	8,034	842	4,543	1,623
QALYs	0.68	0.01	0.63	0.01

the analysis including multiple imputation of costs and outcomes for people who did not complete follow-up are given in the technical report (Davies *et al.*, 2009), Table 26.) The estimates for the constructed counterfactual group appear in the 'no drug treatment' column of Table 12.

**Table 13** *Costs, savings and QALYs gained from structured drug treatment over 51-week period, multiple imputation, controlled for covariates, £s, 2006/07*

	Mean	s.e.
Cost of structured drug treatment	4,531	351
Savings in health and social care	1,686	1,306
Savings in reported offences	10,145	30,789
Total net savings (including offences)	7,301	30,678
QALYs gained	0.05	0.006

The results in Table 12 suggest structured drug treatment was associated with lower costs of other health and social care service use (£3,120 compared with £4,453) and lower average cost of reported offences (£39,967 compared with £50,585). It was also associated with higher QALYs and hence better health status (0.68 versus 0.63). However, investigation of these results suggested that some baseline service and participant characteristics appeared to be correlated with costs or QALYs, but were not included in the estimation of the survey weights, thereby introducing possible bias in the results in Table 12. A standard set of covariates was therefore included to reduce any potential bias caused by possible variation across participants. (Details of the characteristics are given in the methods section of the technical report (Davies *et al.*, 2009).) When the data are controlled for the impact of these additional baseline covariates, the net saving and gain in QALYs associated with structured drug treatment compared with the comparison or counterfactual are maintained (Table 13).

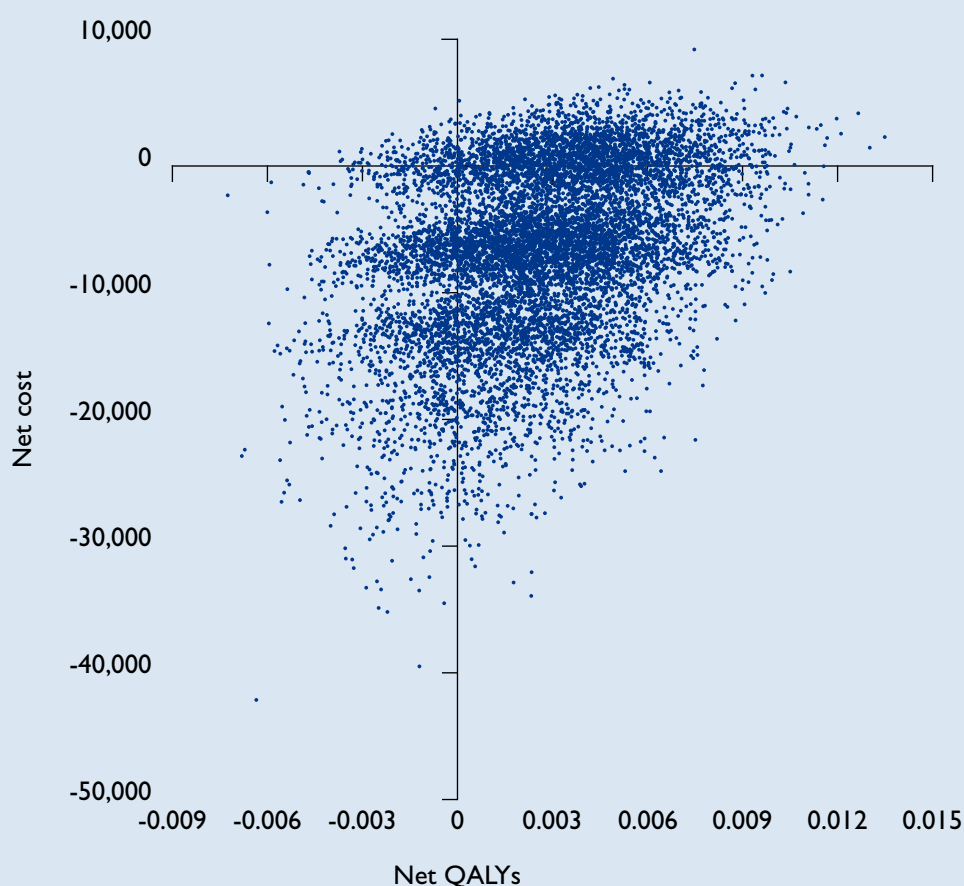
In subgroup analyses, the costs of structured drug treatment, offending or health and social care service use were not found to be related to the source of referral to treatment ( $p=0.65$ ), type of drug used ( $p=0.15$ ) or severity of drug use ( $p=0.71$ ), or previous experience of structured drug treatment ( $p=0.63$ ). This could reflect the inherently variable nature of the underlying data, which reduces the ability statistically to detect relationships where they do exist. Improvements in the health of treatment seekers, as measured by QALYs, were found to be associated ( $p<0.05$ ) with a number of characteristics, reflecting the reduced variability of the QALY data. More detail on these results is provided in the technical report (Davies *et al.*, 2009).

One possible reason for this lack of statistical significance is that the costs and savings vary considerably between individuals in the sample. This reduces the power of the study to find a statistically significant difference where one might exist, given the limited number of participants included in the analysis. An alternative approach to explore the likelihood that structured drug treatment results in a net benefit is to use 'bootstrapping' to simulate the net costs and QALYs that could be expected in a much larger number of observations. Bootstrapping involves producing a large number of predictions for the values of interest based on the statistical properties which have been estimated for a smaller sample of values. This helps to overcome the greater variability encountered in the smaller DTORS sample, and approximates the values one might expect to observe at a 'population' level.

Figure 1 shows the results of bootstrapping 10,000 pairs of net cost and net QALY estimates in the form of a scatterplot known as a cost-effectiveness plane. As before, the analysis is controlled for baseline covariates and sample survey weights. Figure 1 shows that most of the simulated data fall into the bottom right-hand quadrant of the cost-effectiveness plane. This indicates that, in the majority of simulations, structured drug treatment led to net savings and net improvements in health, when compared to no drug treatment.

Table 14 summarises the results of the bootstrapping in terms of the mean net costs and QALYs and the estimated net benefit when the QALY gain is valued at £30,000 per QALY – that is, when policy makers are willing to pay a maximum of £30,000 to gain one QALY in a person seeking structured drug treatment. It can be seen that the overall net benefits associated with structured drug treatment are equal to £6,527 over an average 51 week period, compared to no drug treatment. With structured treatment costs of around £4,500 (Table 13), this implies a cost-benefit ratio of around 2.5:1. For reference, the ratio reported for NTORS was 9.5:1 (Godfrey *et al.*, 2004). However, it should be noted that the NTORS estimated the costs and benefits of drug treatment for a four-year period (two years before treatment and two years following), rather than the one-year (approximately) period of this study. In addition, the scope of NTORS differed from the scope of the current study in terms of the types of costs and benefits it covered, and the monetary values attached to these outcomes also differ. As a result, it is not possible to conclude that drug treatment is now less cost-effective than it was at the time of NTORS.

**Figure 1** Cost- effectiveness plane of bootstrapped net costs and QALYs



The calculated 95 percentiles in Table 14 suggest that the DTORS result is still not statistically significantly different from zero at conventional levels of confidence, despite an extremely low estimated standard error. This would appear to be due to the fact that the results are very highly skewed, with a very small number of extreme outliers, even after trimming the data and applying bootstrapping. However, in such situations, conventional tests of statistical significance are generally inappropriate, and it might be argued that the bootstrapped results shown in the cost-effectiveness plane in Figure 1 (for 10,000 simulations) demonstrate the robustness of the positive mean net benefit estimate. To reinforce this, Table 14 also includes an estimate of the probability that structured drug treatment is cost-beneficial overall when the net costs and benefits

of treatment are combined with the value of health status improvements. This result suggests that, if decision makers are willing to pay £30,000 to gain one QALY in people who seek and use structured drug treatment, structured drug treatment has an 81 per cent chance of being cost-beneficial for that individual.

As discussed above, there is no universally agreed value of a QALY in the UK. An analysis of decisions made by the National Institute for Clinical Excellence, in respect of approvals of drug and other health treatments, suggested a range of implicit values between £15,000 and £30,000 (Rawlins and Culyer, 2004). An approach used in health care is to ask the question: what is the maximum amount decision makers are willing to pay to gain one QALY?

**Table 14:** Bootstrapped net benefits of structured drug treatment over 51-week period, missing observations imputed, controlled for covariates, £s, 2006/07

	Mean	s e	95% percentiles
Net savings	£6,450	£6,779	-£19,737 to £6,836
Net QALY gain	0.003	0.003	-0.003 to 0.008
Net total monetary benefit if willing to pay £30,000 to gain 1 QALY	£6,527	£67	-£2,396 to £19,144
Probability that treatment is cost-effective			0.81

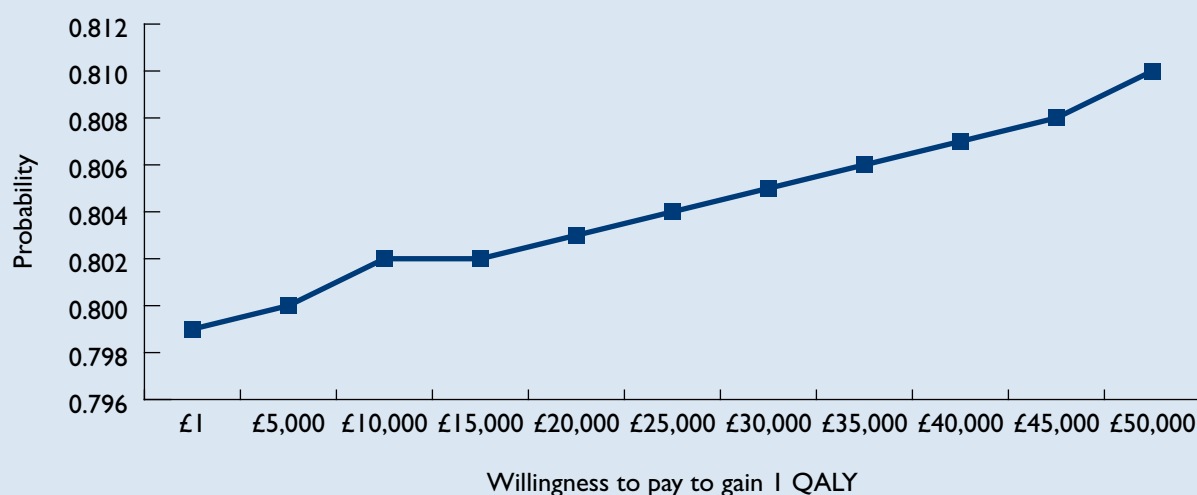
**Figure 2** Probability that drug treatment is cost-effective at different QALY values

Figure 2 presents a 'cost-effectiveness acceptability curve', which shows the likelihood that structured drug treatment is cost-effective (compared with no drug treatment) at different thresholds of willingness to pay to gain one QALY. It suggests that cost-effectiveness is not particularly sensitive to the choice of value for a QALY to the extent that, even if decision makers are only willing to pay £1 to gain one QALY in a drug treatment-seeker, there is a high likelihood that structured drug treatment is cost-effective ( $p=0.80$ ).

gains made on treatment of the majority of individuals are not outweighed by losses incurred by treatment of the remainder.

It should be recalled that DTORS participants were individuals who had received triage and a care plan for drug treatment. Not all of these individuals actually took up or completed the treatment offered to them. One might, therefore, expect both benefits and costs to be higher for those who actually do receive treatment compared with those who do not, although this is not guaranteed. The final sample size of DTORS participants was not sufficiently large to estimate net benefits only for those who did consume treatment services.

## 4. Implications

Evaluation of changes in costs and outcomes for the four weeks prior to each interview provided some evidence that structured drug treatment was effective in improving the health status and utility (i.e. value of that health) in DTORS participants on average. There was also some evidence that structured drug treatment was effective in reducing the costs of other health and social care services, including accommodation.

Taking all costs and outcomes together, the authors' preferred analysis suggests that the mean net benefit associated with structured treatment is positive. At the level of the individual, the probability that structured drug treatment is cost-effective is 81 per cent (based on a value of a QALY of £30,000). This result is derived from 10,000 bootstrapped simulations to compare structured drug treatment to no drug treatment, suggesting that

Further, the analysis does not include the costs of ancillary services which might have been received prior to accessing treatment. For instance, the costs of referral through schemes such as the Drug Interventions Programme are excluded. This means that the estimated net benefits of treatment cannot guarantee the overall net benefits of drug treatment *referral*.

Key strengths of the analysis are, first, that the economic data were collected as part of the DTORS. The DTORS was a national, multi-site, longitudinal study designed to follow a sample of drug treatment seekers over a period of up to 12 months. The study recruited 1,796 participants from 342 treatment facilities in 94 of the 149 Drug Action Team areas in England. Of those recruited at baseline, 1,131 (63 per cent) were interviewed again and 504 were interviewed for a third time, between 11 and 13 months after their baseline interview. This combined with sample survey weights means that the results of the economic analysis are broadly generalisable to the population of people seeking structured drug treatment (Tier 3 and 4) in England.

Second, treatment seekers were assigned to structured drug treatment modalities independently, on the basis of clinical need, suitability and availability. That is, they received whatever treatment was deemed to be the most suitable available option for them at the time of assessment. This means that structured drug treatment in this study is broadly defined by actual practice, which may be more relevant to policy decisions about whether structured drug treatment overall is cost-effective. However, this meant that there was substantial variation in the range and mix of structured drug treatment interventions used by the participants. This means that the analysis does not assess the cost-effectiveness of a clearly defined model of structured drug treatment that can then be replicated elsewhere. In addition, the range of interventions used increases the variability and uncertainty in the data, reducing the ability to identify statistically significant differences.

Third, detailed Tier 3 and 4 drug treatment data were collected for 86 per cent of the DTORS participants from the NDTMS, for the 12 months of scheduled follow-up. This means that the costs of drug treatment were based on observed frequency and intensity of use of drug treatment services, increasing the reliability and accuracy of the data. It also meant that data could be collected for those people who did not complete structured drug treatment (for example, those who had a triage assessment only), which makes the results more generalisable to the population of treatment seekers.

Fourth, the analysis used a broadly societal perspective and included a range of costs and savings associated with the use of other health and social care services and the costs of offences committed by participants. The costs of offences included the costs to the criminal justice system, victims of crime (actual and potential), other public services such as health and social care used by the victims, and other organisations who bear the costs of victimisation (e.g. employers). This means that the net savings found in this study are broadly representative of the benefits to society.

Fifth, the economic analysis uses QALYs to measure the value of any improvements in health to drug users. Based on the cost (saving) and QALY data, cost-effectiveness and cost-effectiveness acceptability analysis directly incorporate and value the benefits of structured drug treatment to drug users. The cost-effectiveness acceptability analysis estimated the probability that structured drug treatment will be cost-effective.

However, there are significant qualifications to the study and these results which need to be borne in mind.

First, the study and results are dependent on the validity of self-reported levels of offending and use of social services. There are generally no alternative sources for these sorts of data, in which case the DTORS is no weaker than any other survey-based study of this kind. In addition, the four-week periods over which survey respondents were asked to report might be considered sufficiently short as to minimise problems with recall. (The NTORS study used a three-month recall period, for instance.) This short recall period did then require the additional assumption that the previous four weeks were representative of the full period between interviews. Furthermore, comparison of the results from DTORS with other measures of self-reported offending in particular (e.g. the Arrestee Survey (Home Office Statistical Bulletin, 04/06)) suggests that a small number of DTORS participants reported much higher levels of offending than might be considered reasonable. Although a small number of these were excluded as clear outliers, the data might continue to be influenced by such respondents, contributing to the high variance in costs of offending, which affects the statistical significance of the results.

Second, there was a high rate of missing follow-up and observations in the DTORS. Only 326 or 18 per cent of DTORS participants had complete records of service use and offences. Two approaches were used to adjust and control for the missing data. Sample survey weights were used to control for the impact of missing follow-up, and multiple imputation was used to provide estimates of the values of missing data. In this way, bias associated with missing data was reduced and estimates of costs and benefits were generated that were more likely to be representative of the DTORS participants and the general population of structured drug treatment seekers. However, this approach might also have introduced greater variance in the estimates, further affecting the measured statistical significance of the results. The approach also relies on the assumption that the missing data were missing at random. If the missing data depend on factors that are observed in the dataset, then the missing data may be treated as missing at random. As long as the missing data do not also depend on the values of unobserved variables, multiple imputation using multivariate analysis is an appropriate method to predict the missing values (Briggs *et al.*, 2003). However, other methods of dealing with missing data may be more appropriate if the missing data do depend on unobserved variables. It is not clear that any method of imputation or controlling for missing data is adequate if there are high levels of missing data.

Third, although the study included some cost types which were not considered in the earlier NTORS study (e.g. costs of childcare and hostel accommodation), some cost types were excluded. For instance, the costs of fraud and some other types of offending were excluded due to the absence of values judged sufficiently robust. Intervention costs were limited to those associated directly with structured drug treatment and excluded the cost to the CJS of referrals to drug treatment. On the other hand, the costs of triage and assessment incurred by drug treatment services vary by source of referral and these differences in costs were included. These exclusions could decrease or increase the estimated net benefits of treatment.

Fourth, the data used to calculate the unit costs of drug treatment, health and social care services and the costs of offences are themselves subject to variation and uncertainty. This is for a number of reasons, including variations between providers that might be due to differences in available resources, practice and effectiveness and differences in the socio-demographic and economic settings of the services. There is also uncertainty due to missing data and lack of routinely collected information with which to estimate the unit costs. These factors might increase the uncertainty and inaccuracy of the cost-effectiveness analysis presented here. If the unit cost data also reflect differences in practice and effectiveness between different modalities in structured drug treatment, this might also systematically affect the cost estimates presented here.

Fifth, and most importantly, for various reasons it was not feasible to include a control or comparator group that did not receive structured drug treatment in the design of the DTORS. To assess the cost-effectiveness of structured drug treatment, a comparison group was constructed that represented what might happen in the absence of structured drug treatment. This assumes that the costs and effects observed at the baseline interview would have remained constant over the year follow-up period. If treatment seekers recover or improve without treatment, this assumption will overestimate the cost effectiveness of treatment. If treatment seekers deteriorate without treatment, this assumption will underestimate the cost-effectiveness of structured drug treatment. The direction of any such changes could vary by outcome. For instance, levels of offending could fall over the follow-up period if referral was associated with a temporary 'burst' of offending which increased the chance of arrest. Health status might be expected to decline over the follow-up period if drug misuse continued.

The absence of a control group means that it is not possible to ascribe any observed changes in outcomes to drug treatment specifically with a high degree of confidence. As such, the results are best seen as suggestive of possible benefits rather than indicative of causation.

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