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Cost-effectiveness of injectable opioid treatment *v.* oral methadone for chronic heroin addiction†

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Background

Despite evidence of the effectiveness of injectable opioid treatment compared with oral methadone for chronic heroin addiction, the additional cost of injectable treatment is considerable, and cost-effectiveness uncertain.

Aims

To compare the cost-effectiveness of supervised injectable heroin and injectable methadone with optimised oral methadone for chronic refractory heroin addiction.

Method

Multisite, open-label, randomised controlled trial. Outcomes were assessed in terms of quality-adjusted life-years (QALYs). Economic perspective included health, social services and criminal justice resources.

Results

Intervention costs over 26 weeks were significantly higher for injectable heroin (mean £8995 *v.* £4674 injectable methadone and £2596 oral methadone; $P<0.0001$). Costs overall were highest for oral methadone (mean £15 805 *v.* £13 410 injectable heroin and £10 945 injectable methadone; $P=$n.s.) due to higher costs of criminal activity. In cost-effectiveness analysis, oral methadone was dominated by injectable heroin and injectable methadone (more expensive and less effective). At willingness to pay of £30 000 per QALY, there is a higher probability of injectable methadone being more cost-effective (80%) than injectable heroin.

Conclusions

Injectable opioid treatments are more cost-effective than optimised oral methadone for chronic refractory heroin addiction. The choice between supervised injectable heroin and injectable methadone is less clear. There is currently evidence to suggest superior effectiveness of injectable heroin but at a cost that policy makers may find unacceptable. Future research should consider the use of decision analytic techniques to model expected costs and benefits of the treatments over the longer term.

Declaration of interest

J.S. and N.L. have contributed to UK National Treatment Agency for Substance Misuse and Department of Health guidelines on the role of injectable prescribing in the management of opiate addiction (2003; chaired by J.S.). J.S. has chaired the broader-scope pan-UK working group preparing the 2007 Orange Guidelines for the UK Departments of Health, providing guidance on management and treatment of drug dependence and misuse. J.S. has provided consultancy advice on possible novel opiate addiction treatments, products and formulations to Britannia/Genus, Auralis/Viropharma, and Martindale Pharmaceuticals, and other pharmaceutical companies. J.S. and his institution have received support and funding from the Department of Health (England) and National Treatment Agency (England); and J.S. has close associations with the charity Action on Addiction. N.L. has received honoraria, travel and conference support, and consultancy fees from Reckitt Benckiser and Schering-Plough. N.L. has an untied educational grant for research related to buprenorphine in the management of opioid dependence. J.S., N.L. and N.M. have previously undertaken a research study of British heroin policy and have given varied commentaries and contributed to professional and public debate.

Heroin addiction is commonly treated with oral methadone maintenance substitution, but about 5–10% of people addicted to heroin who remain in treatment fail to benefit and continue to inject heroin on a regular basis.[1] For this chronic group who persistently fail to benefit from conventional treatments, evidence is emerging to support the effectiveness of maintenance treatment with supervised medicinal heroin (diamorphine) as a second-line treatment for chronic heroin addiction.[2] Injectable opioid treatment with methadone or diamorphine has historically been provided only in the UK[3] but an adapted form has recently been trialled in a number of countries, including Switzerland,[4] Germany[5] and Canada,[6] as well as the UK.[7] Supervised injectable treatments are considerably more expensive than oral methadone treatment, requiring more expensive medications[8] and additional dispensing and supervision resources,[9] with evidence to suggest that they may be four to five times more expensive to deliver.[10] Given increasing resource pressures on health services, injectable treatments may be viewed as an unaffordable luxury. However, value for money is also influenced by treatment outcomes and cost savings elsewhere in the health service or wider community. With the economic and social costs of Class A drug use estimated to be over £15 billion in England and Wales in 2003/04,[11] the potential for cost savings as a result of alternative treatment options should be explored. We present cost-effectiveness data from the Randomised Injectable Opiate Treatment Trial (RIOTT), described in detail elsewhere,[7,9] comparing supervised injectable heroin or injectable methadone with optimised oral methadone for chronic refractory heroin addiction in patients not responding to current oral maintenance treatment.

†See editorial, pp. 325–326, this issue.

Method

Patients and study design

People with chronic heroin addiction (aged 18–65 years) receiving conventional oral methadone maintenance treatment (⩾6 months) were eligible for the study if they were continuing to inject ‘street’ heroin regularly (⩾50% of days in preceding 3 months). Patients were recruited between September 2005 and

August 2008 from supervised injecting clinics in three sites across England (south London, Darlington and Brighton). Patients provided written informed consent and ethical approval was received from the London Multi-site Research Ethics Committee.

Randomisation and masking

Randomisation was undertaken by an independent clinical trials unit using minimisation to assign patients to: supervised injectable heroin (injectable heroin), supervised injectable methadone (injectable methadone), or optimised oral methadone (oral methadone). Randomisation was stratified for: regular cocaine or 'crack' cocaine use ($\geqslant$50% of days in previous 30 days); previous treatment with optimised oral methadone ($\geqslant$80 mg daily; supervised $\geqslant$5 days per week); and clinic site (south London, Darlington or Brighton). In this open-label study, researchers were unmasked to treatment allocation after randomisation.

Treatments

Supervised injectable heroin consisted of twice daily individually titrated injected heroin doses (typically stabilising at 300–600 mg/day, to a maximum of 900 mg/day). Supervised injectable methadone consisted of once daily individually titrated injected methadone (maximum 200 mg/day). All injected doses were self-administered under direct nursing supervision at clinic sites. Oral methadone was additionally prescribed to patients receiving injectable treatment to prevent overnight withdrawal, or if the patient could not attend the clinic for their usual injected doses. Optimised oral methadone consisted of once daily individually titrated doses of $\geqslant$80 mg consumed under direct nursing supervision at clinic sites on $\geqslant$5 days per week, with takeaway doses for weekends. All patients were assigned a case worker for scheduled weekly counselling, monthly medical reviews and access to psychological services. Patients received their allocated treatment for 26 weeks.

Outcome measures

Outcomes were assessed at baseline, 14 and 26 weeks after trial entry. The primary clinical outcome was proportion of participants negative for street heroin in at least 50% of weekly random urine tests during weeks 14–26 ('responders').[7,9] The economic outcome measure was quality-adjusted life-years (QALYs), calculated from the EQ-5D measure of health-related quality of life,[12] using the area under the curve approach.[13] The EQ-5D has been shown to be a valid generic measure of outcome in heroin-dependent populations.[14] Cost-effectiveness was explored in relation to both measures of outcome, however results were similar so only those using QALYs are reported here.

Resource use and costs

The economic evaluation took a broad perspective, including all health and social services, plus the criminal justice sector. Detailed information on resources associated with the three treatments, including medications, equipment, dispensing services, urine tests and contacts with medical, key worker and psychology staff, were recorded for each individual at each clinic. Resources external to the clinics, including supported (staffed) accommodation, health, social services and criminal justice sector contacts and crimes committed were collected during the interview with participants at baseline (covering the previous 6 months) and at 14- and 26-week follow-up. Data were collected using a modified version of the Adult Service Use Schedule (AD-SUS), previously developed by the authors with substance-misusing populations.[15]

All unit costs were for the financial year 2007/08, to correspond with the final recruitment year of the trial. This approach helps to maximise the relevance of the unit costs to the population in the trial and the services they were provided with at the time the trial took place. No adjustments were made for inflation, so these costs may underestimate the costs of providing the same treatment to a current population. However, the relative cost differences between the two groups, on which the statistical analyses are based, should not be greatly affected.

Intervention costs were calculated using a standard micro-costing approach,[16] with adjustments to reflect the long-term costs of a RIOTT clinic in routine clinical practice, as follows.

Drug costs

The costs of oral and injectable methadone were taken from the *British National Formulary*.[8] The cost of injectable heroin was the price paid by the RIOTT clinics at the end of the trial, representing the most efficient market price following negotiations and supplier changes during the trial.

Clinic costs

Clinic costs were based on annual budgets for the year 2007/08, reflecting the most efficient cost structure achieved following supplier and staff adjustments as the clinics evolved over the course of the trial. In addition, efficiency savings achieved by the longest running clinic (London) were applied to the budgets of the other two clinics, where this was believed to reflect the most likely pattern of future supply. A cost-per-hour for clinic staff was calculated on the basis of salary and employer costs plus overheads (utilities, support staff, buildings, management, etc.), weighted to take into account the ratio of time spent in direct contact with clients to time spent on other activities.

Pharmacy costs

Treatment-specific pharmacy cost weightings were calculated using pharmacist estimates of time spent ordering, preparing and managing the distribution of each of the three treatments.

Urine test costs

Random urine tests to detect papaverine and noscapine use in all three groups were taken weekly.[7,17] However, the research team estimated that bi-weekly tests would be more likely in routine practice and tests for street heroin (rather than the cheaper test for opiate use) would only be undertaken for those receiving injectable heroin, so treatment costs were adjusted accordingly.

Nationally applicable unit costs

These were applied to all health and social care contacts, criminal justice system contacts and criminal activity[18–22] as well as supported accommodation, including residential care, residential rehabilitation, hostels and shelters.[19]

Analysis

Economic analysis was carried out on an intention-to-treat basis using an analysis plan drawn up prior to data analysis. Primary analyses compared cost and cost-effectiveness at 26-week follow-up of (a) injectable heroin *v.* oral methadone, and (b) injectable *v.* oral methadone, in line with the primary aims

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of the study.[7] Secondary analyses explored injectable heroin *v.* injectable methadone *v.* oral methadone in a three-way comparison.

Analyses compared mean costs using standard parametric *t*-tests or analysis of covariance with covariates for pre-specified baseline minimisation factors: site (London, Darlington, Brighton), regular cocaine/crack user (yes/no) and currently receiving optimised oral methadone (yes/no). The robustness of the parametric tests was confirmed using bias-corrected, non-parametric bootstrapping.[23] To avoid excessive significance testing, resource use items were not tested for statistical significance.

Cost-effectiveness was assessed through the calculation of incremental cost-effectiveness ratios (ICERs) – the additional cost of one intervention compared with another divided by the additional effects. For the three-way comparison, ICERs were calculated using rules of dominance and extended dominance.[24] Interventions were ranked by cost, from the least to most expensive, and dominated interventions (more expensive and less effective than the previous strategy) were excluded from further analysis. This process compares interventions in terms of observed differences, regardless of statistical significance.

Non-parametric bootstrapping from the cost and effectiveness data was used to generate a joint distribution of incremental mean costs and effects for the treatments under comparison to explore the probability that each is the optimal choice, subject to a range of maximum values (ceiling ratio) that a decision maker might be willing to pay for an additional QALY. Cost-effectiveness acceptability curves (CEAC), a recommended decision-making approach to dealing with uncertainty,[25] were generated by plotting these probabilities for a range of values of the ceiling ratio.[26]

One-way sensitivity analysis was used to explore (a) the impact of hypothesised variations in the price of pharmaceutical heroin, and (b) the narrower National Health Service (NHS)/ personal social services perspective preferred for the National Institute for Health and Care Excellence (NICE) reference case.[27] The National Institute for Health and Care Excellence is responsible for the provision of guidance and advice to improve health and social care in the UK and thus this perspective is of particular relevance to a UK audience. The main analysis, however, will be of value to a broader international audience where guidelines for economic perspectives are known to vary.[28] Single imputation using multiple regression was used for missing total cost data, missing for only 5.5% of the sample ($n=7$). EQ-5D data, missing for only 4% of the sample ($n=5$), was imputed conservatively on the basis of last value carried forward.

Results

Participants

Of 301 patients screened for eligibility, 127 were randomly allocated to supervised injectable heroin ($n=43$), supervised injectable methadone ($n=42$) or optimised oral methadone ($n=42$). Full economic data were available for 94.5% of the sample ($n=120$). Most participants were men ($n=93$, 73%), White ($n=122$, 96%) and unemployed ($n=121$, 95%), had spent time in prison ($n=93$, 73%), and had a mean age of 37.2 years (s.d. = 6.5). Participants had used opiates for a mean of 16.6 years (s.d. = 7.3), had injected drugs for a mean of 13.7 years (s.d. = 7.8) and had received treatment for a mean of 9.8 years (s.d. = 6.7). The full trial profile and description of the participants has been published elsewhere.[7,9]

Resource use

Mean use of resources is summarised in online Table DS1. Participants in all groups spent the majority of the 26-week follow-up living independently. Hostels and shelters were used relatively frequently, particularly by the oral methadone group (mean 50 days *v.* 35 days injectable methadone group, 24 days injectable heroin group). Residential rehabilitation and other types of supported accommodation were used relatively infrequently. Participants accessed a wide range of health and social services. The most frequent contacts were with general practitioners and syringe exchanges, the latter being accessed by a larger proportion of the oral (86%) and injectable methadone (74%) groups than the injectable heroin group (39%). The injectable methadone group spent more nights in prison on average (mean 6.1 nights *v.* 2.2 nights injectable heroin group, 0.4 nights oral methadone group), but crimes committed were substantially higher for the oral methadone group (mean 21 crimes *v.* 7 crimes injectable methadone group, 6 crimes injectable heroin group).

Table 1 provides a breakdown of the total number of each crime committed over the 26-week follow-up. The most common offences committed were theft from shops (23% of participants committing 493 offences) and handling stolen goods (19% of participants committing 383 offences). Other crimes committed relatively frequently included begging, theft from a vehicle and soliciting/prostitution, although these crimes were committed by small proportions of the total population (3–5%). A smaller proportion of the injectable heroin group reported committing any crimes over the follow-up period (37% *v.* 43% oral methadone group, 45% injectable methadone group) and the total number of crimes committed was lower in the injectable drug groups (total: 241 crimes injectable heroin, 278 crimes injectable methadone *v.* 764 oral methadone).

Costs

Total intervention costs over the 26-week follow-up were significantly higher on average for the injectable heroin group (mean £8995 *v.* £4674 injectable methadone and £2596 oral methadone groups; $P<0.0001$) (Table 2). There were no significant differences for other resource categories. The total cost of other health, social services and criminal justice resources were similar across groups (injectable heroin £2632, injectable methadone £2745, oral methadone £2274), as were health and social services alone (injectable heroin £2190, injectable methadone £1865, oral methadone £2023). The cost of crimes committed varied considerably (injectable heroin £1782, injectable methadone £3526, oral methadone £10 962), however these differences were not statistically significant.

Overall, including the cost of the interventions, other services and crimes, the oral methadone group was the most expensive (£15 805), followed by the injectable heroin (£13 410) and methadone (£10 945) groups. From the narrower NHS/personal social services perspective, injectable heroin was the most expensive (£11 186), followed by injectable methadone (£6539) and oral methadone (£4592).

Effectiveness

In intention-to-treat analysis, a higher proportion of participants in the injectable heroin group (72%) were classified as responders (negative for street heroin in ⩾50% of urine tests in weeks 14–26) than those in the injectable and oral methadone groups (39% and 27% respectively). The difference was significant for injectable heroin *v.* oral methadone (odds ratio (OR) 7.42, 95% CI 2.69–20.46, $P<0.0001$), but not for injectable *v.* oral methadone (OR = 1.74, 95% CI 0.66–4.60, $P=0.264$).[7] Quality-adjusted life-years over the follow-up, reported in Table 3, were also higher

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Table 1 Crimes committed over the 26-week follow-up period

	Supervised injectable heroin ($n=41$)		Supervised injectable methadone ($n=42$)		Optimised oral methadone ($n=37$)	
	Committing offence, *n* (%)	Total number of offences	Committing offence, *n* (%)	Total number of offences	Committing offence, *n* (%)	Total number of offences
Theft from shops	8 (20)	137	13 (31)	129	6 (16)	227
Handling stolen goods	9 (22)	38	7 (17)	77	7 (19)	268
Begging	1 (2)	40	2 (5)	15	3 (8)	132
Theft from a vehicle	2 (5)	8	1 (2)	2	2 (5)	65
Soliciting/prostitution	1 (2)	2	2 (5)	18	1 (3)	10
Theft from the person	0 (0)	0	2 (5)	13	1 (3)	6
Robbery of personal property	1 (2)	1	1 (2)	1	1 (3)	10
Going equipped for stealing	0 (0)	0	0 (0)	0	1 (3)	10
Criminal damage to a vehicle	0 (0)	0	0 (0)	0	1 (3)	9
Burglary in dwelling	0 (0)	0	2 (5)	6	0 (0)	0
Burglary in a building other than a dwelling	0 (0)	0	1 (2)	3	0 (0)	0
Robbery of commercial property	0 (0)	0	2 (5)	2	1 (3)	1
Criminal damage to a dwelling	1 (2)	1	1 (2)	2	0 (0)	0
Breach of peace/drunk and disorderly	0 (0)	0	2 (5)	2	1 (3)	1
Common assault	0 (0)	0	2 (5)	2	0 (0)	0
Theft of a pedal cycle	0 (0)	0	0 (0)	0	1 (3)	1
Possession of weapons	0 (0)	0	1 (2)	1	0 (0)	0
Other	3 (7)	14	2 (5)	5	2 (5)	24
Total	15 (37)	241	19 (45)	278	16 (43)	764

for the injectable heroin group (mean 0.27) than the injectable and oral methadone groups (mean 0.24 in both groups), but not significantly so ($P=0.8475$).

Cost-effectiveness

Figure 1(a) shows the scatter plot of the bootstrapped total cost (intervention plus all health, social service and criminal justice resources) and effectiveness (QALYs) pairs for injectable heroin *v.* oral methadone. The ICER (denoted by a square) and the majority of the scatter points are located in the south-east quadrant of the cost-effectiveness plane, indicating that injectable heroin is associated with lower total costs (below the x-axis) and better effects (to the right of the y-axis) than oral methadone, and is said to be dominant. The CEAC in Fig. 1(b) demonstrates there is a higher probability of injectable heroin being more cost-effective than oral methadone irrespective of a decision maker's willingness to pay for an additional QALY. At a willingness to pay of £30 000, commonly considered the maximum for an additional QALY in the UK,[29] there is a 70% probability that injectable heroin is more cost-effective than oral methadone. The results comparing injectable with oral methadone are similar, as illustrated in Fig. 2.

Comparing all three treatments, oral methadone was dominated by both injectable heroin and methadone, and was excluded from further analysis. Supervised injectable heroin was associated with higher total costs per participant than supervised injectable methadone (bootstrapped incremental cost £2931) but better effects (bootstrapped incremental QALYs 0.05). The scatter points (Fig. 3(a)) fall mainly within the north-east quadrant of the cost-effectiveness plane, indicating a trade-off where additional effects of injectable heroin can only be gained at greater cost. The associated CEAC (Fig. 3(b)) demonstrates that at low levels of willingness to pay for an additional QALY, there is a greater

Table 2 Total costs over the 26-week follow-up period

	Mean (s.d.) per participant, £			
	Supervised injectable heroin ($n=41$)	Supervised injectable methadone ($n=42$)	Optimised oral methadone ($n=37$)	ANOVA P^a
Intervention costs	8995 (2907)	4674 (2105)	2569 (1082)	<0.0001
Drug costs	1814 (862)	720 (383)	205 (114)	<0.0001
Clinic costs	5578 (1872)	2571 (1307)	1047 (493)	<0.0001
Weekly case management	1026 (628)	984 (663)	922 (615)	<0.0001
Urine tests	577 (198)	398 (169)	394 (170)	<0.0001
Other service use	2632 (5603)	2745 (3093)	2274 (2644)	0.097
Staffed accommodation	493 (1186)	660 (1081)	783 (1121)	0.510
Hospital services	1380 (4362)	486 (1077)	622 (1419)	0.129
Community services	317 (645)	719 (1044)	618 (623)	0.051
Criminal justice services	442 (1139)	880 (2613)	251 (934)	0.302
Crimes committed	1782 (3844)	3526 (8939)	10 962 (40 985)	0.378
Total cost over 26 weeks	13 410 (5962)	10 945 (9235)	15 805 (42 908)	0.637
Total cost per week	457 (195)	373 (324)	529 (1419)	0.603

a. Adjusted for site (London, Darlington, Brighton), regular cocaine/crack user (yes/no) and currently receiving optimised oral methadone (yes/no).

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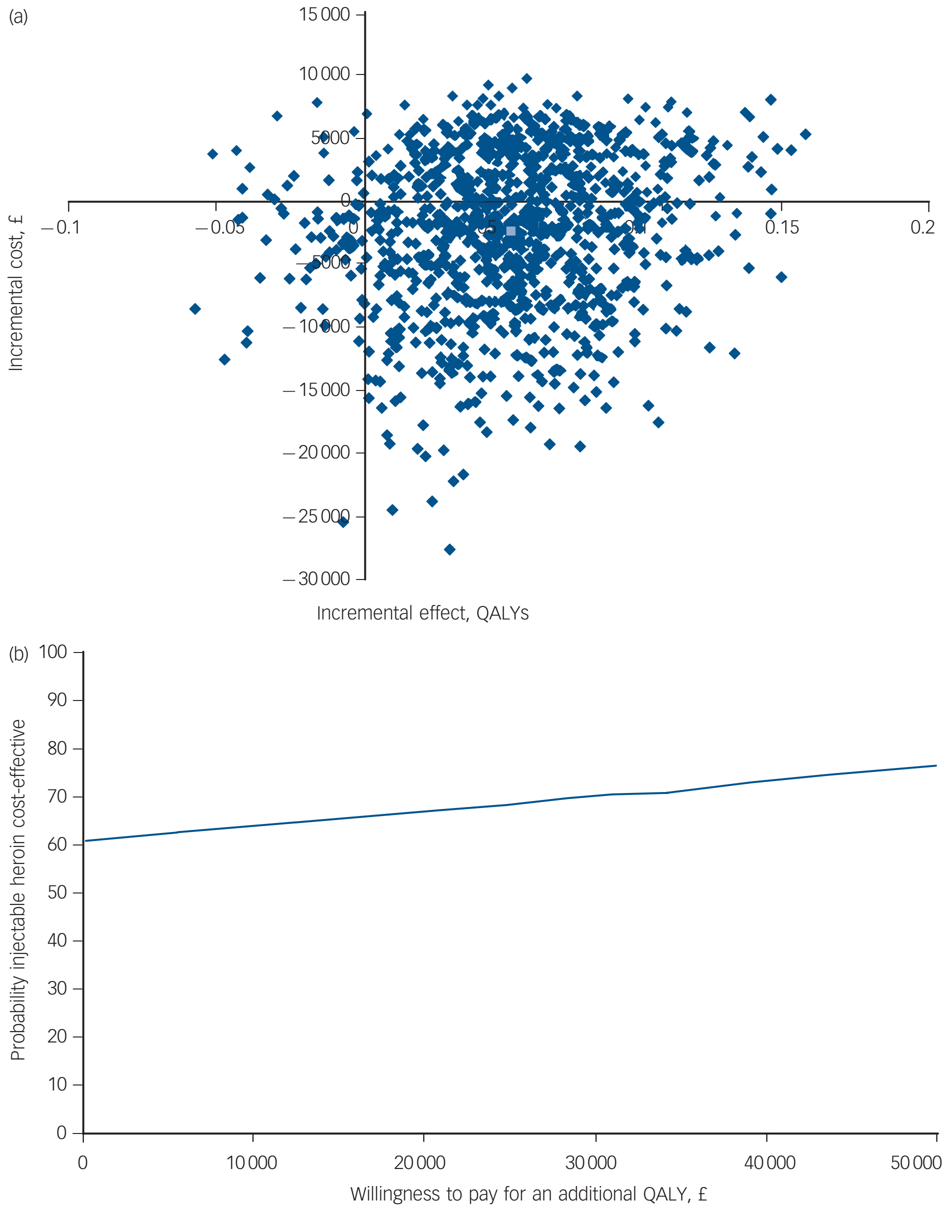

Fig. 1 Supervised injectable heroin *v.* optimised oral methadone (a) bootstrapped cost and effectiveness pairs for quality-adjusted life-years (QALYs) and (b) cost-effectiveness acceptability curve for QALYs.

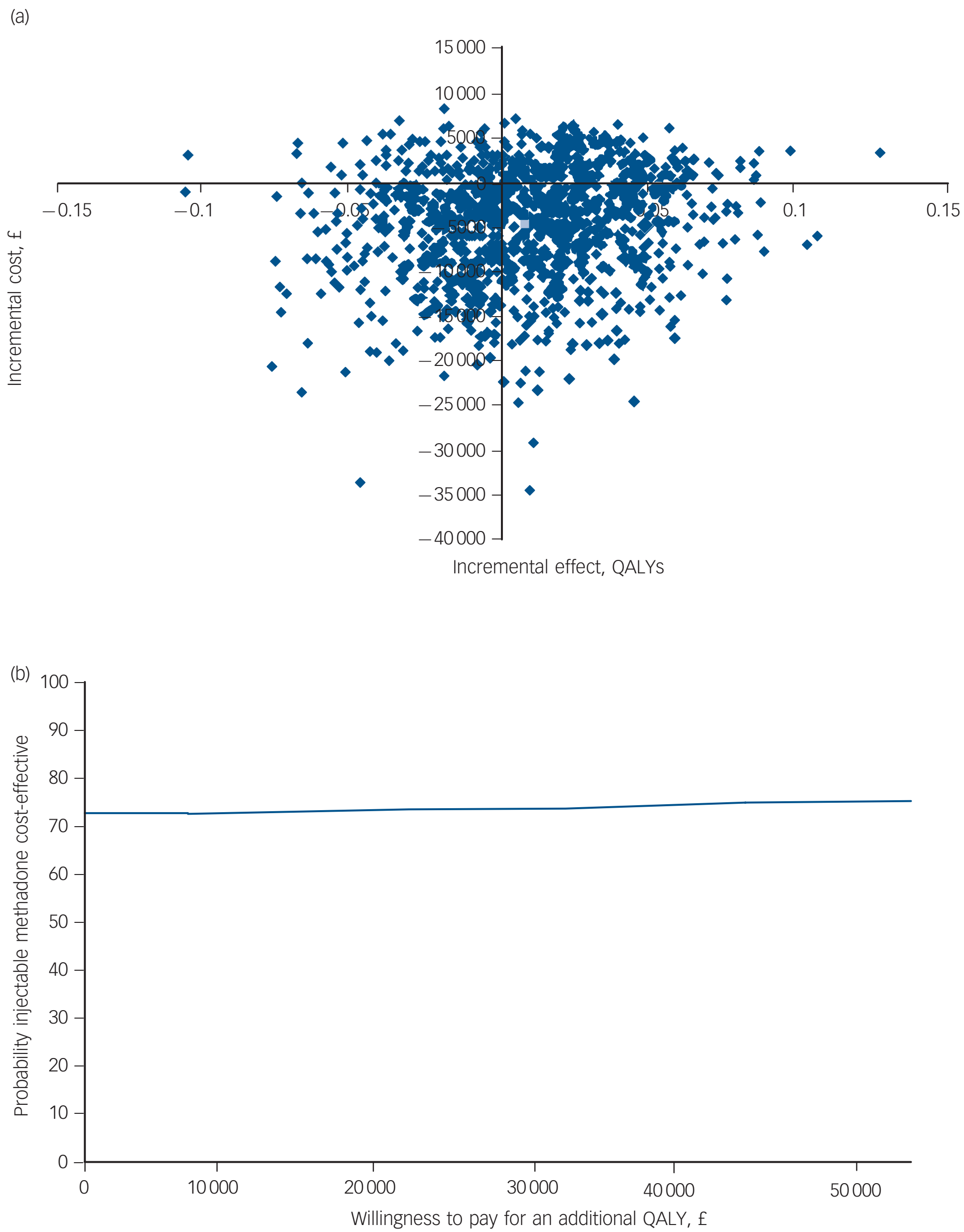

Fig. 2 Supervised injectable methadone *v.* optimised oral methadone (a) bootstrapped cost and effectiveness pairs for quality-adjusted life-years (QALYs) and (b) cost-effectiveness acceptability curve for QALYs.

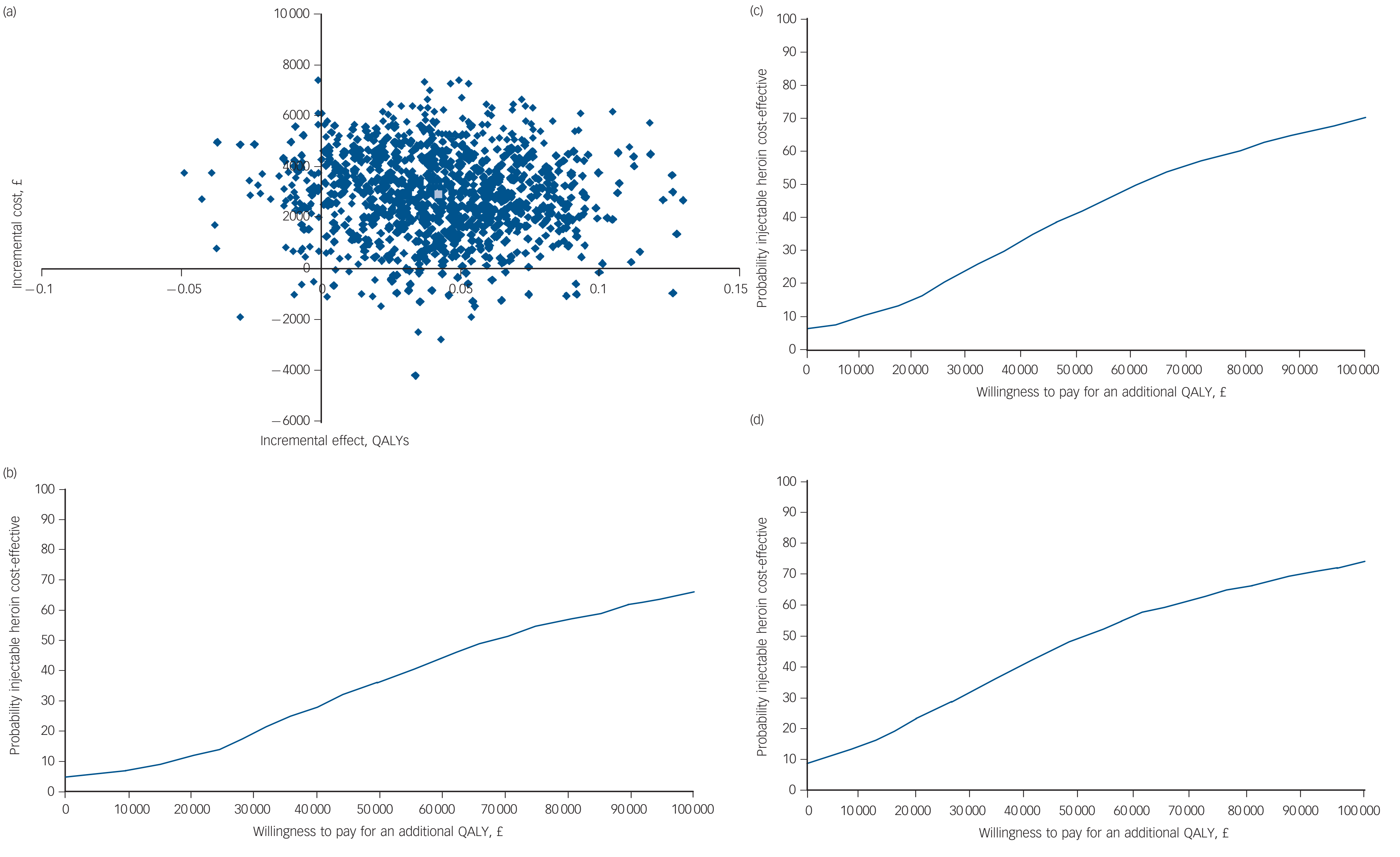

Fig. 3 Supervised injectable heroin *v.* supervised injectable methadone: (a) base-case bootstrapped cost and effectiveness pairs for quality adjusted life years (QALYs) and cost-effectiveness acceptability curves for: (b) base-case analysis; (c) price of heroin = £10; and (d) price of heroin = £7.

Table 3 EQ-5D scores (tariffs) and quality-adjusted life-years

	Supervised injectable heroin (*n* = 43)		Supervised injectable methadone (*n* = 42)		Optimised oral methadone (*n* = 42)	
	Weeks since baseline	Mean (s.d.)	Weeks since baseline	Mean (s.d.)	Weeks since baseline	Mean (s.d.)
EQ-5D tariff						
Baseline	0.00	0.43 (0.46)	0.00	0.39 (0.51)	0.00	0.38 (0.47)
14-week follow-up	16.50	0.47 (0.48)	16.67	0.39 (0.50)	16.15	0.40 (0.44)
26-week follow-up	29.49	0.50 (0.45)	29.71	0.47 (0.53)	29.91	0.46 (0.45)
Quality-adjusted life-years		0.27 (0.25)		0.24 (0.28)		0.24 (0.25)

probability of injectable methadone being the more cost-effective of the two strategies (probability injectable methadone more cost-effective at £30 000 per QALY 80%, injectable heroin 20%). Supervised injectable heroin becomes the more likely to be cost-effective at willingness to pay levels of around £70 000 and above, substantially above the maximum threshold of £30 000 per QALY.

Sensitivity analysis

The base-case analysis applied the price paid by the RIOTT clinics for pharmaceutical injectable heroin at the point the trial ended (£12.50 per 500 mg preparation). Although this price represents the most efficient market price at that time, any decision to increase the availability of injectable heroin in the UK may have an impact on the long-term supply cost. Increased demand will commonly influence production processes and encourage additional suppliers into the market, thus reducing costs through productive efficiencies and economies of scale. Discussions with suppliers suggest current supply may be feasible at a cost of £10 per 500 mg, and future supply on a wider scale could see the price fall to £7 per 500 mg. Applying a price of £10 per 500 mg (Fig. 3(c)), supervised injectable methadone remains the more likely to be cost-effective at a maximum willingness to pay for a QALY of £30 000 (probability injectable methadone more cost-effective 75%, injectable heroin 25%). The results are the same when applying £7 per 500 mg (Fig. 3(d)), although the probability of injectable methadone being the more cost-effective strategy at a cost per QALY of £30 000 reduces (injectable methadone 66%, injectable heroin 33%). Threshold analysis suggests that the price of pharmaceutical injectable heroin would need to fall to £2 per 500 mg preparation before there was a greater probability of injectable heroin being the more cost-effective option at a cost per QALY of £30 000 than injectable methadone.

The base-case analysis takes a broad cost perspective which includes the criminal justice sector, known to be important in substance misusing populations.[30] This is contrary to the NHS/personal social services reference case perspective preferred by NICE for UK guidelines.[27] Applying this narrower perspective, oral methadone was found to dominate both injectable heroin and methadone as a result of lower health and social service costs alongside only small differences in outcome between groups (Fig. 4).

Discussion

Cost-effectiveness

Cost-effectiveness analysis from a broad perspective demonstrates that injectable treatments dominate oral methadone treatment for chronic refractory heroin addiction, even when efforts are made to optimise oral methadone treatment. However, cost-effectiveness is being driven by savings in the criminal justice sector, not the health sector, with injectable treatments being cost-ineffective compared with oral methadone when the narrower health and social service perspective is taken. These findings are supported by similar research in The Netherlands comparing co-prescribed heroin and methadone with methadone maintenance alone, which

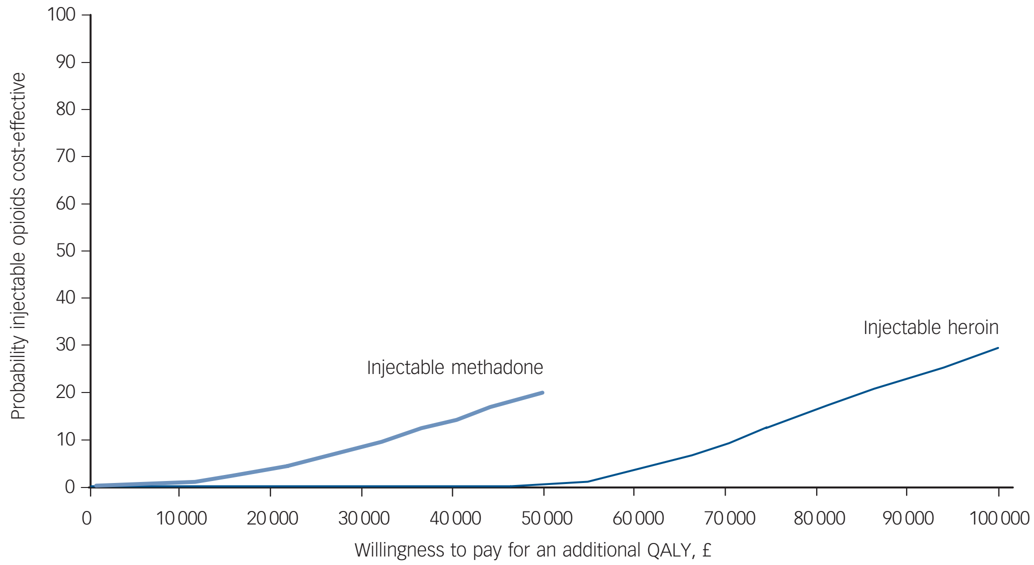

Fig. 4 Supervised injectable heroin and supervised injectable methadone *v.* optimised oral methadone cost-effectiveness acceptability curve for quality adjusted life years (QALYs) – National Health Service/personal social services perspective.

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found that the addition of heroin generated better outcomes, and the additional treatment costs were offset by lower criminal justice costs.[31]

Since reductions in crime and savings to the criminal justice sector are important policy aims,[32] it is appropriate to consider these broader costs in evaluations involving populations where crime is a relevant resource burden, as acknowledged in NICE guidelines that support the presentation of broader perspectives where costs to other government bodies are believed to be significant.[27] A narrow perspective is without theoretical foundation[33] and, in this instance, would support an intervention that saved health and social care resources compared with the injectable alternatives, but was less effective, associated with higher levels of criminal activity and, overall, placed a greater burden on the public sector purse. Focusing on the more appropriate broader perspective, these findings suggest that injectable alternatives should be preferred to oral treatments but that some compensation may be needed to support clinics in the provision of the more expensive, but also more cost-effective, treatments.

Clinical evidence from the RIOTT study suggests that supervised injectable heroin may be more effective than supervised injectable methadone.[7] However, the economic evidence, although supporting the cost-effectiveness of both injectable opiate treatments compared with oral methadone in this treatment-resistant population, does not support the cost-effectiveness of injectable heroin compared with injectable methadone. Relative cost-effectiveness was found to be sensitive to the price of pharmaceutical diamorphine, but the price would have to fall considerably before injectable heroin became the more likely of the two options to be cost-effective. Budgetary pressures are also a factor for consideration. Detailed micro-costing found injectable methadone to be approximately twice the cost of optimised oral methadone, while injectable heroin was 3.5 times the cost. Thus, the provision of supervised injectable heroin is also likely to be dependent on clinical funding.

Limitations

The study is limited in a number of ways. First, the large cost differences between groups did not reach statistical levels of significance, due to high levels of variance in the cost of crimes, resulting from small numbers of prolific offenders. To achieve statistical significance, a much larger sample would be needed. However, the cost of such a trial may be prohibitive. Instead, a decision-making approach was taken which explored the likelihood of one treatment being more cost-effective than another, given the data currently available.[25]

Second, the results are limited by reliance on self-reported levels of criminal activity. Although more accurate data on recorded arrests, convictions and incarcerations may be available,[34] such data do not measure the true economic impact of criminal activity, since costs are associated with all crimes committed, not just those involving arrest or conviction.[20]

Third, the study is limited by a relatively short follow-up which may not be long enough to capture the full economic implications in this chronic population. In particular, the appropriateness of focusing on generic measures of outcome, such as QALYs, which are generally preferred by economists and policy-making bodies,[28] in a population still primarily dependent on heroin is unclear. Instead, QALYs may be of more value in longer-term analyses. Future research to model the long-term consequences of treatment in this population may be of particular value.

Finally, the results presented here are generalisable to chronic heroin addiction populations who fail to benefit from conventional treatment and continue to inject heroin on a regular basis. They may be of less relevance to populations who are treated successfully with conventional oral methadone maintenance. In addition, the results may not reflect standard clinical practice in relation to the oral methadone arm of the trial, which was optimised in a way that may not happen in all routine clinics. However, this provided a more stringent test of the injectable opioid treatments, since in routine practice the oral methadone group may have demonstrated poorer outcomes than those reported here.

Implications

Our results do not support the continuing provision of oral methadone maintenance treatment alone for chronic refractory heroin addiction, despite the relatively low treatment costs in comparison to injectable alternatives. However, policy makers will need to compensate clinics for providing a more expensive service that generates cost savings primarily for the criminal justice sector. The choice of which injectable treatment to provide is less clear. There is currently evidence to suggest superior effectiveness of supervised injectable heroin but at a cost that policy makers may find unacceptable. Future research should consider the use of decision analytic techniques to model expected costs and benefits of the treatments under alternative assumptions regarding future demand for and supply of, and thus cost of, pharmaceutical diamorphine and indeed methadone and, perhaps most importantly, longer-term evidence of impact on quality of life.

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