Deep brain stimulation compared with methadone maintenance for the treatment of heroin dependence: a threshold and cost-effectiveness analysis


Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

CRD summary
This study assessed the success threshold at which deep brain stimulation could produce the same or better cost-effectiveness, as methadone maintenance therapy, for patients who were dependent on heroin. The authors concluded that further research was warranted, given the relatively low success threshold (49%), and the projected cost-effectiveness of stimulation. There was considerable uncertainty around the cost-effectiveness of stimulation and the value of further research was not assessed.

Type of economic evaluation
Cost-utility analysis

Study objective
This study assessed the success threshold at which a theoretical course of deep brain stimulation, produced the same or better quality of life and cost-effectiveness, as methadone maintenance therapy, for patients who were dependent on heroin.

Interventions
Deep brain stimulation consisted of surgery to place an electrode into the subcortical structures to modulate the targeted brain regions. Methadone was the standard treatment to mitigate withdrawal and prevent heroin use in those who were heroin dependent.

Location/setting
USA/in-patient and out-patient care.

Methods
Analytical approach:
The authors created a six-month decision tree. Patients could have deep brain stimulation, resulting in abstinence or heroin relapse, with or without complications of surgery. Alternatively, they could receive methadone and be heroin abstinent, have reduced heroin use, or relapse before completing six months of treatment. The authors stated that they took a societal perspective.

Effectiveness data:
The primary measure of clinical effectiveness was heroin abstinence. With deep brain stimulation, patients were abstinent or not, while on methadone, they could have partial success. To estimate the likelihood of being heroin-free on methadone, the authors conducted a literature review and a meta-analysis. The model assumed different levels of effectiveness for deep brain stimulation, in the absence of data for heroin addicts. The risk of complications from surgery was from trials of deep brain stimulation for the treatment of movement disorders.

Monetary benefit and utility valuations:
The utilities, for the health states, were from UK non-drug users and were elicited using the standard gamble method. The utility decrements for the complications of surgery were from published studies of patients who were not heroin addicts.

Measure of benefit:
Quality-adjusted life-years (QALYs) were the summary measure of benefit.

Cost data:
The cost data were primarily from published US government reports. They included the direct medical costs for addicts and victims of crime, productivity losses for addicts and victims, and criminal system costs. The costs of the interventions were from published sources. The costs of complications were from several published studies and from the US Centers for Medicare and Medicaid Services. The price year was 2011, and all costs were reported in US $.

Analysis of uncertainty:
There was no data for deep brain stimulation in heroin addicts, so a threshold analysis was conducted to ascertain how effective stimulation had to be to match or beat the QALY gain or cost-effectiveness of methadone. Different cost-effectiveness thresholds were assessed. The effects of varying each input for the model independently were assessed.

Results
The incremental cost-effectiveness ratio for stimulation versus methadone was plotted against the probability of stimulation being effective. Assuming a threshold of $180,000 per QALY gained, methadone was less costly and more effective at or below 36.5% likelihood of successful stimulation. Above a success rate of 36.5%, deep brain stimulation produced more QALYs, but was not cost-effective. Above 49%, it was cost-effective.

The sensitivity analysis showed that the likelihood of successful stimulation was the most influential factor, followed by the utilities for different health states.

Authors’ conclusions
The authors concluded that the evidence supported investment in a clinical trial, based on the relatively low success threshold (49%) necessary for deep brain stimulation to be equivalent to methadone, and its projected cost-effectiveness.

CRD commentary
Interventions:
The interventions were well described. The authors acknowledged that there were two other treatments for heroin dependence, buprenorphine maintenance therapy and heroin-assisted treatment. Another comparator was not considered; buprenorphine plus naloxone. The authors justified the exclusion of buprenorphine, because systematic reviews had found it was less cost-effective than methadone. Heroin-assisted therapy was a criminal offence in the USA. The exclusion of these two treatments was reasonable. Buprenorphine plus naloxone was a new treatment, so its exclusion was reasonable.

Effectiveness/benefits:
There were no effectiveness data for deep brain stimulation compared with methadone, so the authors conducted a threshold analysis to identify the success rate for stimulation at which it became cost-effective. The estimate of the likelihood of being heroin-free on methadone was from a literature review and meta-analysis, conducted by the authors. The methods for the literature search and the inclusion criteria for the meta-analysis were not reported. The six-month analysis for a chronic disease, where patients might relapse after successful treatment, was unlikely to have fully assessed the benefits and costs of methadone and deep brain stimulation. Six months was chosen to match the length of the trials that had been conducted, rather than to match the pathology of heroin addiction. The authors acknowledged that this was a limitation. The estimates in the model are unlikely to be generalisable to the actual treatment of heroin dependence. The utilities were assessed for UK volunteers, rather than addicts, which means that the QALYs may not be applicable to heroin addicts in the USA, and may not be applicable to heroin addicts, in general.

Costs:
The costs were from appropriate US settings and were adequately reported. The six-month model is unlikely to have adequately represented the costs of the interventions, as it is unlikely to have adequately represented the pathology of heroin addiction.

Analysis and results:
The analyses of cost-effectiveness used a threshold of $180,000 per QALY gained, based on a study that estimated the
willingness-to-pay for health care in the USA, rather than the customary $50,000 per QALY gained. The authors presented a graph showing the required success rate for deep brain stimulation, for different cost-effectiveness thresholds. As they acknowledged, the length and structure of their model did not accurately capture the treatment pathway and health outcomes of heroin addiction. It did not consider relapse after six months of methadone, nor the permanency of deep brain stimulation effectiveness, both of which are likely to influence long-term cost-effectiveness. The sensitivity analyses were well reported and varied all the pertinent variables, but were limited to one-way analysis, which does not fully capture the overall effect of uncertainty in the model.

Concluding remarks:
There were no comparative effectiveness data and the model structure was limited in its representation of the treatment pathway and health outcomes of heroin addiction. There was therefore considerable uncertainty around the potential cost-effectiveness of deep brain stimulation. Further research would provide more information, but this analysis did not evaluate the value-for-money of doing further research.

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