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Effects of Drug Substitution Programs on Offending among Drug-Addicts

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Executive Summary/Abstract

BACKGROUND

Drug abusers are generally more involved in crime, in particular property crime, than people who are not drug abusers. Substitution programs have been developed in order to improve drug users' quality of life and to decrease their criminal involvement. Several evaluations, but not all, have reported crime reductions following substitution therapies based on heroin and methadone prescription.

OBJECTIVES

This systematic review is aimed at gaining an overall picture on the respective effects of prescription of methadone vs. heroin and other substances.
Search strategy: Six databases (Medline, Campbell Crime and Justice Group, National Criminal Justice Reference Service, National Treatment Agency for Substance Misuse, JSTOR and Criminal Justice Abstracts) as well as relevant journals and websites (Harm reduction Journal, Journal of Substance Abuse Treatment, Drug and Alcohol Dependence, Drug and Alcohol Review, Drug and Therapeutics Bulletin, International Journal of Drug Policy, Journal of Clinical Psychopharmacology, Déviance et Société, Criminal Justice and Behavior, Criminologie, www.heroinstudie.de and www.drugscope.org.uk) have been searched for relevant studies meeting the inclusion criteria.

SELECTION CRITERIA

To be eligible, studies had to assess the effects of any substitution therapy (using e.g. methadone and/or opiates as substitution drugs). Only effects on offending have been considered. Comparisons of competing treatments (substitution therapy vs. any other form of treatment, including placebo treatment or no treatment at all) were restricted to studies meeting level 4 or higher on the scale developed by Sherman et al. (1997). In addition, one-group pre-post evaluations of substitution therapies were included because changes in offending are substantial compared to pre-treatment levels, while comparisons of treatment with several substances often show modest differences. Finally, studies that assessed the impact of drug

substitution at the macro (i.e. city or regional) level were also included. The three different types of studies have been analyzed separately.

DATA COLLECTION AND ANALYSIS

66 studies were considered, and 46 were selected for inclusion in the review. They separately assess the impact of methadone, buprenorphine, heroin, naltrexone, dihydrocodeine or Levo-alpha-acetylmethadone substitution on the criminal behaviour of opiates addicts. Meta-analytic techniques were used to identify overall effects of several substances. Comparisons of different treatments (i.e. substitution vs. any other treatment) were restricted to studies meeting levels 4 or 5 on the scale developed by Sherman et al. (1997).

MAIN RESULTS

Heroin maintenance reduces crime significantly more than Methadone maintenance. Methadone maintenance reduces offending more than treatments without substitution therapy, but the mean effect size is not significant ($p > .1$). However, very large (and significant) reductions in criminal behaviour are observed during methadone maintenance therapy with respect to pre-treatment levels. Buprenorphine does not significantly reduce criminal behaviour, although effects are positive, be it with respect to methadone or a placebo. Naltrexone treatment reduces criminality significantly more than behaviour therapy or counselling.

CONCLUSION

Heroin maintenance has been found to significantly reduce criminal involvement among treated subjects, and it is more effective in crime reduction than methadone maintenance. Methadone maintenance greatly reduces criminal involvement, but apparently not significantly more so than other interventions. Buprenorphine and Naltrexone have been found to be promising, although few studies have been identified using these substances in maintenance treatment.

1 Background of the Review

For the last decades, drug addiction has become an increasingly worrying problem throughout the Western World. Drug-addicts have been disproportionately involved in criminal activities, making drug-addiction, beyond public health concerns, a formidable challenge to public order. In 8 European countries, burglaries, robberies and other serious crimes increased by several hundred percent between 1970 and 2000 (Killias, 2002, p.115). Comparison of self-reported delinquency in 7 countries (Killias & Ribeaud 1999) suggest that the extent of involvement in property crime among addicts of any kind of hard drugs is about 10 times higher than among non-users. Thus, the increasing trends of robbery and burglary in many Western countries between 1970 and 1995 may reasonably also be seen as a side-effect of increasing drug use.

In response to this phenomenon, numerous programs have been set up to provide drug addicts with narcotics (e.g., heroin prescription programs) and substitution drugs. The intended goals of such treatments have been:

(1) to improve drug users' quality of life, reducing the risks of overdose or contagious diseases, controlling the quality of drugs available on local markets, preventing marginalization and improving social integration,
(2) to diminish social costs of drug addiction,
(3) to reduce drug-related offences and protect public order. It is assumed that drug addicts commit many predatory offences mainly to finance the purchase of drugs, and that criminality will decrease once drugs are supplied to addicts through official channels. The same effect should be observed if drug addicts are supplied with products (such as methadone) that suppress physical effects of withdrawal and, indirectly, the immediate need to consume drugs,
(4) to reduce public order problems of all sorts. If addicts obtain drugs through official channels, they should spend less time in the search for drugs, which means that they have more time available for legitimate earnings and will less concentrate in places where addicts and dealers regularly gather (e.g., "needle" parks in Switzerland).

Many researchers have studied the effects of drug prescription programs on criminal behaviour among participants. We shall review these programs and try to find out whether they have been effective in reducing criminality.

2 Objectives of the Review

The review aims at evaluating the effects of drug prescription and substitution programs on criminal behaviour among participants. To be included in this review, studies have to assess the effects of drug substitution on offending. If this review reveals significant effects of such programs on criminality, the results could have implications for crime and justice as well as for drug policies. For example, if the results of our meta-analysis support the conclusion that heroin maintenance reduces criminality, medical prescription of heroin could be an option in the treatment of severely addicted drug users with high criminal involvement whenever reductions in offending is among the priorities.

3 Methods

3.1 SEARCH STRATEGY FOR IDENTIFICATION OF RELEVANT STUDIES

Relevant studies have been identified through abstracts, bibliographies and databases such as Campbell Crime and Justice Group (C2-SPECTR), National Criminal Justice Reference Service (NCJRS), Medline, Harm Reduction Journal, Journal of Substance Abuse Treatment, National Treatment Agency for Substance Misuse (NHS), National Treatment Outcome Research Study (NTORS), Drug and Alcohol Dependence, Drug and Alcohol Review, Drug and Therapeutics Bulletin from the BMJ group (DTB), International Journal of Drug Policy, Central Committee on the Treatment of Heroin Addicts (CCBA), Journal of Clinical Psychopharmacology, Criminal Justice Abstracts (CJA), Déviance et Société, JSTOR, Criminal Justice and Behavior (CJB), Criminologie, the German literature (Heroinstudie.de-www.heroinstudie.de/H-Report P2 engl.pdf) and www.drugscope.org.uk.

Furthermore, the bibliographies of relevant reviews (Amato *et al.*, 2005; Farrell *et al.*, 1994; Ferri, 2005; Hall, 1998; Holloway, 2005; Kosten *et al.*, 1993; Luty, 2003; Prendergast, 2002) have been consulted.

The keywords that have guided the search for references in databases and bibliographies were the following: drug addiction; drug prescription; substitution programs; controlled trial; re-offending; heroin; methadone; opiates, treatment programs; drug abuse; drug addict, heroin prescription, property crime, cocaine abuse; dexamphetamine; cocaine substitution. In addition, the following combinations of keywords have been used: substitution program + re-offending; heroin + treatment programs; heroin + substitution program; heroin + methadone; opiates + treatment; opiates + substitution; heroin + property crime; substitution programs + property crime, cocaine abuse + dexamphetamine.

Being that the staff of the University of Zurich Institute for Criminology and Criminal Law is multi-lingual, studies published in any of the following languages were eligible for inclusion: English, French, German, Dutch, Italian, Spanish, Portuguese, Romanian, Polish, Ukrainian and Russian. In the protocol, it was foreseen that contacts would be established through international channels, such as

the European Sourcebook Group (with its network of correspondents in more than 40 countries), the European Society of Criminology and the International Society of Criminology, with countries not routinely covered in international reviews of research. No relevant studies were identified through these channels, however. Studies published in any language after 1960 have been considered.

3.2 CRITERIA FOR INCLUSION AND EXCLUSION OF STUDIES IN THE REVIEW

Randomized studies, quasi-experimental studies and before-after comparisons on the effects on offending of drug substitution programs have been included. Interventions can be court-ordered or unrelated to any involvement of the criminal justice system. Only interventions based on substitution programs (using e.g. methadone and/or opiates as substitution drugs) will be considered. Possible effects beyond offending have not been considered, in particular eventual medical outcomes. A coding protocol was prepared along the guidelines of the Campbell Collaboration. Moreover, our review complies with the current standards of meta-analysis (e.g. as specified in Practical Meta-Analysis by Lipsey & Wilson).

3.3 TYPES OF STUDIES

Studies meeting level 4 or higher on the scale developed by Sherman *et al.* (1997) have been considered for comparing competing treatments. In addition and in order to give the reader the full picture, pre-post studies have been included and mean effect sizes have been computed. Such studies are useful in the present context because changes in offending are often substantial compared to pre-treatment levels, while comparisons of treatment with several substances often show modest differences.

Thus, the following types of studies have been included:

(1) *One-group, pre/post studies*: studies comparing individual delinquency rates before, during and following treatment. To be eligible, studies had to include the prescription of a drug (e.g., methadone, heroin).

(2) *Multi-group comparison studies, including both true experimental studies (randomized designs) and quasi-experimental designs*: studies comparing delinquency rates among subjects of an experimental group before, during and following treatment to those of a control group (with or without random assignment). As in the previous paragraph, studies were eligible only if the treatment group underwent substitution therapy. As a control group, we considered any group undergoing an alternative treatment or no treatment at all (including placebo control). For example, if the treatment group was treated with heroin as a substitution drug, the control group could remain untreated or may have received any

other substance as a substitution drug (e.g., methadone). It may also have undergone abstinence therapy with or without psychotherapy, detoxification, etc.

(3) *Macro level studies*: studies assessing the impact of drug substitution at the macro (*i.e.* city, regional) level. In order to be eligible, such studies needed to measure the impact of the program on delinquency at the city/regional level, using police, court or survey data.

The three different types of studies have been analyzed separately. All of the studies taken into account assess the effects of drug substitution programs on offending.

The inclusion criteria have been restrained with respect to the protocol due to the large number of studies of levels 2 and 3. Whereas pre-post studies have been summarized below (Table 5), studies of level 3 have been dropped since a sufficient number of high-quality group comparisons (levels 4 and 5) have been identified (Tables 1, 2, 3 and 6).

3.4 TYPES OF PROGRAMS

3.4.1 Type of intervention

Studies reporting effects of drug prescription and drug substitution programs on criminality among drug users have been included. By drug substitution program we understand programs that include the prescription of substances rather than programs based on drug abstinence. Methadone detoxification has not been considered as a substitution program, since the finality is abstinence and doses of methadone are reduced to zero after a relatively short period. The prescription must imply substances considered as substitutes for illegal drugs, for example, methadone or buprenorphine as a substitute of heroin. This excludes the prescription of drugs such as tranquillizers or antibiotics, frequently prescribed to drug users. However, studies using Naltrexone®, an opioid antagonist, have been included as well. The medically assisted prescription of heroin has also been included. This does not mean that heroin is a substitute of heroin, but that the uncontrolled consumption of heroin in the streets is replaced by the prescription of a controlled dosage of heroin, adapted to the user's needs.

Programs that do not include prescription of any substance have not been considered, such as programs based exclusively on, for example, psychotherapy, detoxification, etc, except in control groups where the treatment group underwent a substitution intervention. Only interventions based on substitution therapy (using e.g. methadone and/or opiates as substitution drugs) have been considered.

3.4.2 Kinds of drugs to be substituted by programs

All drugs that are illegal according to international agreements and local (national) laws, such as heroin, morphine, opium, cocaine, crack, ecstasy, amphetamine, LSD, ketamine, cannabis, fentanyl, inhalants etc.

3.4.3 Context of programs

Any program, no matter whether treatment is court-ordered or unrelated to any involvement of the criminal justice system. Programs involving incarcerated drug-addicts have not been considered since re-offending cannot be adequately tested as long as offenders remain in prison. Studies where treatment commences in prison but re-offending is measured after release have been included.

3.5 TYPES OF OUTCOME MEASURES

The key outcome measure considered is offending as measured by reconviction data, police records and studies on self-reported delinquency. Drug possession and consumption has not been considered expressly as a measure of offending although it is an offence in most countries. Since in many studies the overall number of crimes (as measured by self reports, arrests, convictions or incarcerations) is reported, drug possession and consumption is certainly included in some of these general outcome measures. To the extent that studies address the effects at the macro level, any conventional outcome measures (statistics, crime victim surveys etc.) have been considered.

To assess improvement at the individual level, prevalence rates (or percentage of people who re-offend) as well as incidence rates (or number of offences committed per person) during standardized pre- and post-intervention periods have been considered. Prevalence rates inform on *how many persons* are diverted from criminal activity by prescription of substitution products, whereas incidence rates allow assessing whether *fewer offences* are committed as a result of the program. It is important to make this distinction since a given program may reduce the number of offences without affecting the number of offenders.
Possible treatment effects beyond offending, such as medical outcomes or effects of such programs on drug markets have not been considered.

3.6 TYPES OF PARTICIPANTS

The considered population consists of drug-addicts (*e.g*. heroin addicts, cocaine addicts), adults and adolescents, males and females.

3.7 DESCRIPTION OF METHODS USED IN THE COMPONENT STUDIES

The methods used by the studies covered by this review can be the following ones: Randomized studies, quasi-experimental studies and before-after comparisons.

All studies included in this review will have a measure of the effects of drug substitution treatments on offending such as arrest, conviction, incarceration or self-reports.

3.8 CRITERIA FOR DETERMINATION OF INDEPENDENT FINDINGS

There are three potential sources of non-independence of findings. We shall use the same criteria as in similar Campbell Review Protocols (*e.g*. Lipsey and Landenberger (2006); Wilson *et al*.(2007)).

The first potential source of non-independence of findings is multiple indicators of offending reported from a single study (e.g. arrest, conviction). When more than one such outcome is reported, only one will be selected for the analysis. To maintain as much comparability as possible across studies, coders have selected the outcome measure that is most frequently represented in other studies in the collection (Lipsey et al., 2006). This has been "all offences", measured usually at the level of arrests or self-reports. If "all offences" was not available, any among several outcomes was selected randomly.

The second occurs when the same outcome is measured at multiple points in time, e.g., 6-months, 12-months, 18-months and two years post-treatment. In those cases, the measure with the timing closest to that most commonly used across all the studies (12 months) has been chosen to maximize comparability between studies (Lipsey et al., 2006).

Finally, the third source of non-independent findings is the same data being reported across multiple documents. We have used author's names, court location and study time frames as well as sample descriptions to identify multiple publications of the same evaluation. When such multiple publications were identified, the most complete and detailed manuscript was designated as the primary coding source. Additional manuscripts have been consulted to elaborate coding if necessary (Wilson et al., 2007).

3.9 DETAILS OF STUDY CODING CATEGORIES

A coding protocol was developed for this synthesis that provides for a systematic method of extracting information regarding each study's research design, program, nature of the outcome measure, and outcome data (see appendix- Coding Protocol).

3.10 STATISTICAL PROCEDURES AND CONVENTIONS

Our review complies with the current standards of meta-analysis (*e.g*. as specified in *Practical Meta-Analysis* by Lipsey & Wilson).

The three types of studies mentioned above (pre/post studies, randomized controlled trials and quasi-experimental designs, and macro-level studies) have been synthesized and meta-analyzed separately.

The effect of drug prescription or substitution programs on criminal behaviour was encoded using the odds-ratio. The odds-ratio is well suited to dichotomous outcomes, such as those commonly used in drug treatment. When offending was measured (quasi-) continuously (crime days, number of arrests), a standardized mean difference type effect size was computed and transformed into an odds-ratio (see Lipsey & Wilson, 2001). For pre-post studies, odds ratios have been computed between t_0 and t_1. An odds ratio of >1.0 indicates that treatment reduced offending, and an odds ratio of <1.0 was used whenever treatment was unsuccessful. Effect size outliers (›± 3.0 standard deviations) would have been winsorized to less extreme values (next highest not judged an outlier); however, no such outliers were observed. In addition, no data were imputed for missing values.

For the computation of mean-effect sizes, the inverse variance method of meta-analysis (Lipsey & Wilson, 2001) was used. In the first place, fixed-effect models were fitted. Whenever the Q-test refuted homogeneity, a random effects model was adopted.

3.11 TREATMENT OF QUALITATIVE RESEARCH

No qualitative research was included in this systematic review.

4 Findings

4.1 OVERVIEW

In Medline, 3,791 studies have been found using the searches with combined keywords. All different searching strategies together yielded 459 references to be retained for further examination; 68 are reviews, 220 have been rejected as being out of the scope of the present review (of these, 168 are available as full text versions), and 171 have been retained as being of interest (of these, 152 are available as full text). Among the 171 references retained, there are cases where several articles refer to a same study, while not necessarily reporting the same results. Sixty-six studies have been coded. 46 of these either fulfil criteria of Sherman 4 or higher or are pre-post comparisons or population studies and have therefore been included in the present review.

4.2 EFFECTS OF HEROIN SUBSTITUTION TREATMENT

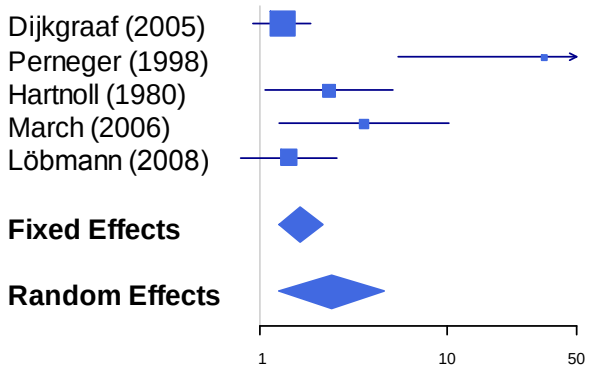
Among the coded eligible studies, 6 concern Heroin substitution programs, and 5 are randomized controlled trials (RCTs). In four of the RCTs, the control group undergoes methadone maintenance (Dijkgraaf, 2005; Hartnoll *et al.*, 1980; Löbmann *et al.*, 2008; March *et al.*, 2006), while in one (Perneger, 1998) the control group undergoes any conventional treatment (mostly Methadone maintenance treatment, MMT). A general description of these studies is available in the appendix, Table A1. One study is an intake-follow up investigation of the efficacy of Heroin (Killias *et al.*, 1999). It was excluded from the models shown below. The effect sizes retained for these studies as well as the Random- and Fixed effects model effect sizes are reported in Table 1 below.

Table 1: Studies where treatment group receives Heroin maintenance and the control group either methadone or another standard treatment.

First author	Year	Outcome	OR	CI low	CI high	p
Dijkgraaf	2005	Arrest / property crime	1.33	0.94	1.88	0.11
Perneger	1998	Charged/any offense	33.52	5.52	203.6	0.0001
Hartnoll	1980	Arrest/any offense	2.37	1.08	5.22	0.03
March	2006	Commission / any offense	3.64	1.29	10.31	0.015
Löbmann	2008	Charged / theft	1.43	0.79	2.59	0.24
Fixed effects			1.65	1.27	2.16	0.0002
Random effects			2.44	1.27	4.69	0.0072
Killias	1999	Conviction / any offense	6.58	4.46	9.69	<0.0001

Notes: (1) The first five studies are RCTs and have been included in the model, while the last one is a pre-post study and that was excluded from the model.
(2) An odds ratio >1.0 stands for a reduction in offending after treatment.
(3) p is based on z-tests.

Figure 1: Forest plot[1] for the comparison described in table 1. The size of the boxes is proportional to the weight of the study in the summary measures. The confidence interval for the study by Perneger et al (2008) has been cut for representation (arrow).



The standard deviation for all effects is 14.04; none of the studies was therefore winsorized. However, the study by Perneger (1998) includes 21 subjects in control group, and 27 in the treatment group; also, the confidence interval for this odds ratio is [5.52;203.6] and therefore, effects observed are very variable, certainly due to (1) the heterogeneous control group and (2) a small sample size. The Killias et al.

[1] Forest plots have been constructed using R (www.r-project.org).

(1999) study may have a higher effect size because subjects in the Swiss heroin trial were selected for treatment considering particularly their high criminal involvement.

The hypothesis of homogeneity is here rejected. If Perneger (1998) is not included in the analysis, due to the different treatment of the control group with respect to all other included studies, homogeneity is accepted. The Fixed effects mean effect size is then 1.55 [1.18; 2.02] (p=0.0015). Here, a significant decrease in the criminality measures is, therefore, present for Heroin rather than Methadone maintenance.

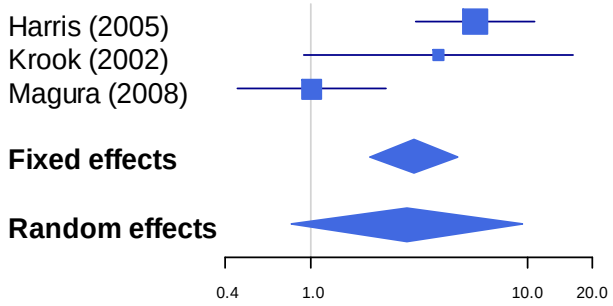
4.3 EFFECTS OF BUPRENORPHINE SUBSTITUTION TREATMENT

For the effect of Buprenorphine on criminal behaviour, 4 studies have been found. 3 of these are RCTs. In two, the control group is in MMT (Harris *et al.*, 2005; Magura *et al.*, 2008, while in the third (Krook, 2002), the control group receives a placebo only. The individual and overall effects are shown in Table 2 below, while general descriptors of the studies are presented in the Appendix (Table A2). The fourth study (Kakko et al., 2003) is a randomized controlled trial as well, but the measure of criminality is only given for the treatment group in pre-post form.

Table 2: Studies where treatment group receives Buprenorphine maintenance. The first 3 are RCTs, while in the last the crime measure is only given in a pre-post form.

First author	Year	Outcome	OR	CI low	CI high	p
Harris	2005	Cost of crime / any offense	5.74	3.03	10.86	<0.0001
Krook	2002	Commission / any offense	3.88	0.92	16.40	0.07
Magura	2008	Arrest / any offense	1.01	0.46	2.22	0.99
Fixed effects			2.98	1.86	4.77	<0.0001
Random effects			2.78	0.81	9.53	0.10
Kakko	2003	Commission / any offense	2.41	077	7.53	0.13

Figure 2: Forest plot for the comparison described in table 2. The size of the boxes is proportional to the weight of the study in the summary measures.



The hypothesis of homogeneity is refuted (Q test p=0.0033), and when the study with a differing control group (Krook et al., 2002) is excluded, this remains so (Q test p=0.0008). Overall, there is therefore no significant reduction in criminality when Buprenorphine instead of Methadone is used, although the effects have a tendency to be positive with Buprenorphine with respect to Methadone (or Placebo).

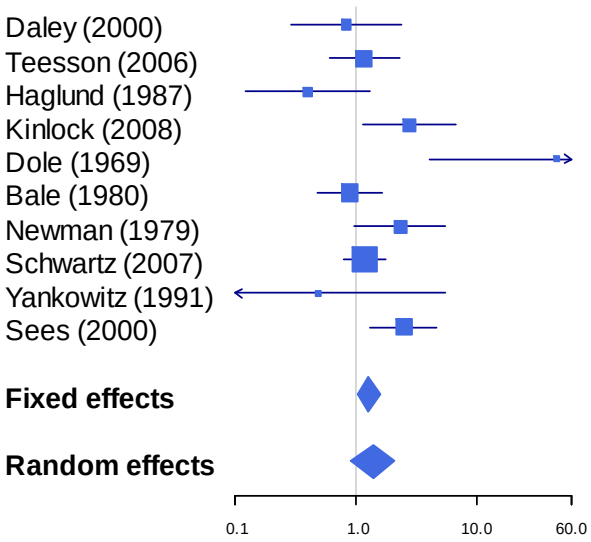
4.4 METHADONE MAINTENANCE TREATMENT (MMT)

For methadone maintenance, 41 studies have been found and coded; 2 of these are population studies, 11 are quasi-experimental studies (but 8 are Sherman 2 or 3 and have therefore been excluded, since a large number of studies have been found), 21 are pre-post studies and 7 RCTs. The included studies are 7 RCTs and 3 quasi-experimental studies. Among the RCTs, the control groups differ widely: three are waiting-list controls (Dole *et al.*, 1969; Schwartz *et al.*, 2007; Yancovitz *et al.*, 1991), in one the control group receives a placebo (R. Newman *et al.*, 1979), in one the control group receives counselling (Kinlock, 2008), in one the control group receives detoxification (Sees *et al.*, 2000), and in one the control is treatment community (Bale et al., 1980). Among the quasi experimental studies, two controls are detoxification (Daley, 2000; Haglund *et al.*, 1978) and one residential treatment (Teesson, 2006). A general description of these studies is given in the Appendix, Table A3.

Table 3: Studies fulfilling criteria of Sherman 4 or 5 where treatment group receives Methadone maintenance vs. control group with no substitution treatment.

First author	Year	Outcome	OR	CI low	CI high	p
Daley	2000	Cost of crime / any offence	0.83	0.29	2.34	0.72
Teesson	2006	Commission / any offence	1.16	0.60	2.24	0.65
Haglund	1987	Arrest / any offence	0.39	0.12	1.29	0.12
Kinlock	2008	Incarceration / any offence	2.73	1.12	6.67	.0.03
Dole	1969	Incarceration / any offence	45	4.04	500.71	0.002
Bale	1980	Arrest / any offence	0.88	0.48	1.61	0.68
Newman	1979	Conviction / any offence	2.29	0.97	5.4	0.06
Schwartz	2007	Illegal income / any offence	1.18	0.78	1.77	0.44
Yankowitz	1991	Incarceration/ any offence	0.49	0.04	5.43	0.56
Sees	2000	ASI legal / any offence	2.47	1.31	4.63	0.01
Fixed effects			1.34	1.06	1.70	0.01
Random effects			1.40	0.91	2.16	0.12

Figure 3: Forest plot for the comparison described in table 3. The size of the boxes is proportional to the weight of the study in the summary measures. The confidence intervals of Dole (1969) and Yankovitz (1991) are cut for the representation (arrows).



Again, homogeneity analysis refutes the hypothesis of homogeneity (p=0.0047). The random effects model does not indicate a significant effect of methadone maintenance with respect to these control groups; the mean effect measure is, however, in favour of Methadone maintenance.

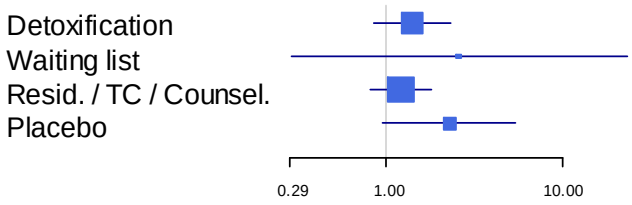
When groups are analysed separately by control groups, the between group variability is not significant. Also, homogeneity is not rejected for the detoxification (p=0.35) and counselling/residential treatment / treatment community (TC) control groups (p=0.63). Detailed results are given in table 4.

Table 4: Effects on criminal behaviour for Methadone maintenance by type of treatment offered to the control group. Studies included fulfil Sherman 4 or 5.

Control	Nb of studies	Mean ES	CI ES low	CI ES high	p
Detoxification[a]	3	1.41	0.86	2.31	0.17
Waiting list[b]	3	2.58	0.29	22.8	0.39
Resid. / TC / Counsel. [a]	3	1.22	0.82	1.82	0.32
Placebo [a]	1	2.29	0.97	5.4	0.06

Effect sizes indicated are based on a [a] fixed effects model and [b] a random effects model. P is based on z-tests.

Figure 4: Forest plot for the comparison described in table 4. The size of the boxes is proportional to the inverse variance of the odds ratio in every group of studies.



Therefore, Methadone maintenance has no significantly better effect on criminality than any of these control treatments. Also, a non-significant but positive effect of Methadone maintenance over all other control conditions is detected.

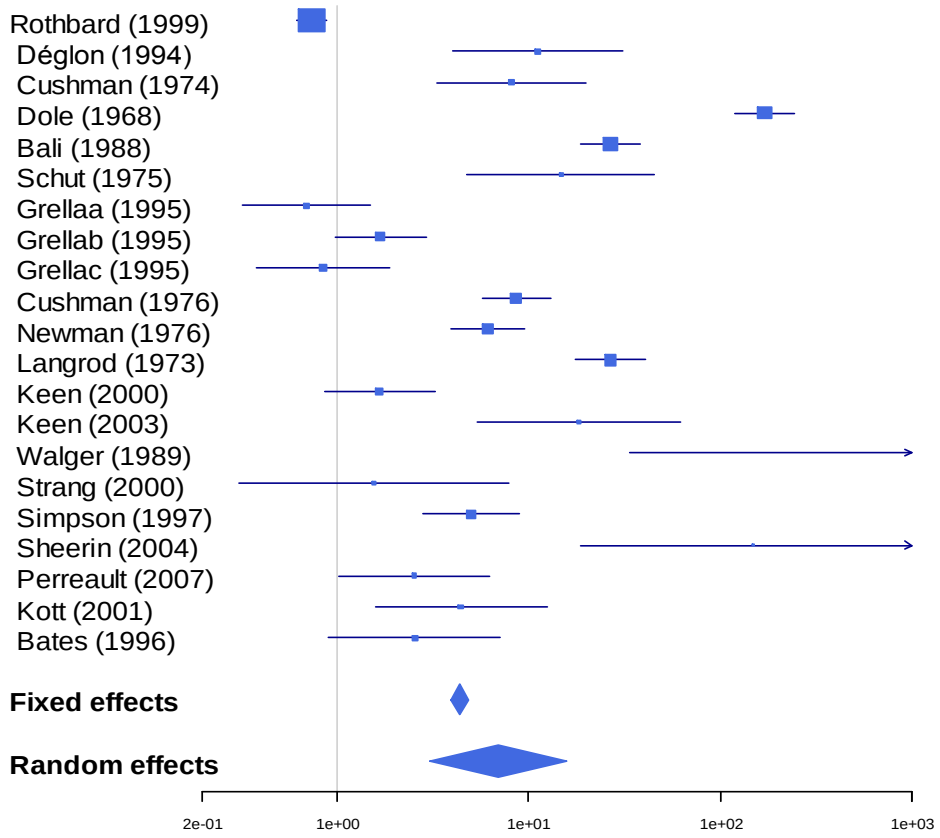
In table 5, the results for the pre-post (or rather, during) studies using methadone are reported. One of these studies is a randomized controlled trial of oral versus intravenous methadone delivery (Strang *et al.*, 2000); only the pre-post results of the oral methadone group are presented here, since it was decided to compare different substances of substitution rather than dosages or ways of administration. Effect sizes (log odds ratios) have been computed by comparing pre-treatment levels of offending and average individual offending rates during maintenance treatment. This explains the sometimes very large odds ratios obtained. Also, the maximum effect size obtained (1081) is observed in a study with only 24 participants.

Table 5: Pre-post studies of Methadone maintenance

First author	Year	Outcome	OR	CI low	CI high	p
Rothbard	1999	Arrest /Any offence	0.74	0.62	0.89	0.0017
Déglon	1994	Days incarcerated / any offence	11.17	4.05	30.80	<0.0001
Cushman	1974	Arrest / property offence	8.18	3.36	19.92	<0.0001
Dole	1968	Conviction / any offence	170.44	118.67	244.82	<0.0001
Bali	1988	Commission / any offence	26.68	18.72	38	<0.0001
Schut	1975	Arrest / violent offence	14.79	4.81	45.43	<0.0001
Grella[a]	1995	Commission / theft	0.69	0.32	1.49	0.34
Grella[b]	1995	Commission / theft	1.69	0.98	2.92	0.06
Grella[c]	1995	Commission / theft	0.85	0.38	1.87	0.68
Cushman	1976	Arrest / any offence	8.63	5.72	13.01	<0.0001
Newman	1973	Arrest / any offence	6.14	3.94	9.57	<0.0001
Langrod	1973	Arrest / any offence	26.8	17.72	40.64	<0.0001
Keen	2000	Conviction and caution / any offence	1.67	0.86	3.27	0.13
Keen	2003	Commission / property crime	18.25	5.41	61.64	<0.0001
Walger	1989	Incarceration / any offence	1081	33.34	35041	<0.0001
Strang	2000	Commission / property offences	1.57	0.31	7.85	0.55
Simpson	1997	Commission or incarceration / any offence	5.02	2.81	8.96	<0.0001
Sheerin	2004	Commission / any offence	148.50	18.56	1188	<0.0001
Perreault	2007	Earning from illegal activity	2.53	1.02	6.27	0.04
Kott	2001	Arrest / any offence	4.44	1.58	12.48	0.0047
Bates	1996	Conviction / any offence	2.56	0.91	7.17	0.07
Fixed effects			4.37	3.94	4.86	<0.0001
Random effects			6.92	3.04	15.77	<0.0001

[a] Results for white [b] for African-American and [c] for Latino women

Figure 5: Forest plot for the comparison described in table 5. The size of the boxes is proportional to the weight of the study in the summary measures. The confidence intervals for Walger (1989) and Sheerin (2004) have been cut for representation (arrows).



The hypothesis of homogeneity is again rejected. Here, a beneficial effect of methadone maintenance is observed with respect to baseline. This in no way contradicts results obtained above, where Methadone is not significantly more effective than other substances in reducing criminality; indeed, these pre-post studies only show decreasing criminality during treatment, not whether this is a comparatively effective treatment or even whether the effect is due to being in treatment or to the passage of time.

As for the two population studies, only general results will be reported here since none includes comparison macro units. The first one, carried out by Niveau *et al* (2002) reports a significant positive correlation of crime known to the police in Geneva with the number of addicts in MMT (with r of 0.71 [0.73; 0.68]). In a reaction, however, Aebi (2001) observed that the overall population of drug addicts needs to be taken into account in such a trend analysis. When this is done, the effect turns in favour of MMT with a significant r of -0.19 [-0.14;-0.24]. In the second population study (Maddux & Desmond, 1979), a negative correlation is obtained, with an r of -0.93 [-1.03, -0.84].

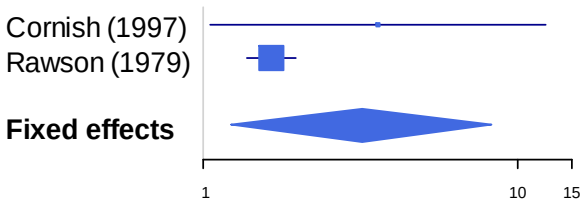
4.5 EFFECTS OF NALTREXONE TREATMENT

While Naltrexone is not a substitution treatment (rather the prescription of an inhibiting substance) it is included; effects are shown in table 6. Two RCTs have been found, one contrasting Naltrexone with counselling (Cornish et al., 1997) and one with behaviour therapy (Rawson, 1979); also, one pre-post trial is shown in table 6 (De Jong *et al.*, 2007). The descriptors of the studies included in the meta-analysis are given in the Appendix, Table A4.

Table 6: Effects of Naltrexone on criminal behaviour

First author	Year	Outcome	OR	CI low	CI high	p
Cornish	1997	Incarceration / any offense (+ probation violation)	3.61	1.06	12.35	0.04
Rawson	1979	Incarceration / any offense	1.66	1.39	1.99	<0.0001
Fixed effects			3.21	1.23	8.31	0.02
Random effects			3.21	1.23	8.31	0.02
De Jong	2007	EuropASI justice / police	2.67	0.59	12.09	0.20

Figure 6: Forest plot for the comparison described in table 6. The size of the boxes is proportional to the weight of the study in the summary measures.



Here, homogeneity is not rejected by the test; Naltrexone is here shown to have a significant and beneficial effect on criminal behaviour with respect to psychological interventions.

4.6 EFFECTS OF OTHER SUBSTITUTION TREATMENTS

Finally, two RCTs have been found that use other replacement therapies: one where Levo-alpha-acetylmethadone (LAAM) is compared to MMT (Eissenberg et al., 1997) and one where MMT is compared to Dihydrocodeine (Robertson et al., 2006). In the first case, the effect favours LAAM; the effect size is 1.93 [0.16, 22.31] and the effect is not significant. However, very serious side-effects (torsade de pointes) have been observed with this substitution drug that is, for this reason, unavailable in Europe. In the second case, the effect size is 0.96 [0.39; 2.37] and is not significant either.

5 Discussion

Two systematic reviews of substitution programs have been carried out to be included in the Cochrane database of systematic reviews: Ferri *et al* (2006) and Mattick *et al* (2006). While these reviews do not focus on delinquency as an outcome measure, a comparison of results with the present report seems relevant. In Ferri *et al* (2006), 4 trials comparing methadone maintenance to Heroin maintenance are included. One study showed a reduction in the risk of being charged when on Heroin maintenance; this in line with the results obtained here. Also, two studies considered criminal offending and social functioning in a multi domain outcome measure, and again, heroin plus methadone maintenance yields better results than methadone alone. Again, this is in line with the results obtained here, i.e. heroin maintenance reduced criminality more than other maintenance treatments.

In Mattick *et al* (2006), three studies comparing methadone maintenance to no opioid replacement therapy with respect to their effect on criminal behaviour are included. The results obtained are similar to the results obtained here in two respects: firstly, the effect of methadone maintenance seems to reduce criminal behaviour more than the alternatives, and secondly, this effect is not significant.

6 Conclusion

Heroin maintenance reduces crime significantly more than Methadone maintenance. Methadone maintenance itself does not have a significant effect on criminal behaviour; in particular with respect to two detoxification and one treatment community program, the effect is even negative. While Methadone maintenance is, with respect to reductions in offending, not to be the preferred treatment, it was found to be promising in comparison to detoxification, treatment community, counselling and residential treatment, placebo and waiting list controls. These reductions are not significant, while very large (and significant) reductions in criminal behaviour are observed during Methadone maintenance with respect to pre-treatment levels.

Buprenorphine does not significantly reduce criminal behaviour, although effects are strictly positive, be it with respect to Methadone or a placebo.

Finally, a quite different treatment has been evaluated here as well: Naltrexone. This treatment reduces criminality significantly more than behaviour therapy or counselling.

Overall, crime reduction among addicts, though important in itself, will probably not be the only goal to give attention to. This review does not address other (possibly different) effects of substitution therapy on other goals, such as promoting abstinence or improving health.

7 Plans for updating the Review

This review will be updated every five years to include new treatment studies published in any language. The primary authors will take the lead in this update.

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11 Appendix: Tables of General Study Descriptors

Table A1 : General description of studies included in the meta-analysis where the treatment group receives Heroin

First author	Year	Outcome	Measure	n_{exp}	$n_{control}$	$Outcome_{exp}$	$Outcome_{control}$	Duration	Treatment experimental	Treatment control
Dijkgraaf	2005	arrests / property crime[1]	Self-report	193[2]	237[2]	37(134)	65(207)	12 months	Methadone + Heroin	**Methadone**
Perneger	1998	Charged/any offense	Self-report	27	24[3]	20/5[4]	7/12[4]	196 days	Heroin	**Standard (many methadone)**
Hartnoll	1980	Arrest/any offense	Self-report (checked against official records if possible)	42	46	52%	72%	12 months	Heroin	**Methadone**
March	2006	Commission / any offense	Nb days involved in criminal activity ; Self-report	31(27)	31(23)	12(13.7)[5]	3.8(7.6)[5]	9 months	Methadone + Heroin	**Methadone**
Löbmann	2008	Charged / theft	Official data	419	406	12.4%/9.5%[2]	13.3%/12.4%[6]	12 months	Heroin	**Methadone**

[1] mean (sd) for 100 participants
[2] initial numbers; 135 (70%, experimental) and 204 (86%, control) patients completed 12 months of treatment
[3] In the control group, only data for 21 participants is available and has been used.
[4] In the 6 months before the trial/after 196 days of trial (mean)
[5] diminution of mean number of days of crime with respect to t0
[6] In the month before beginning treatment/after 12 months of treatment

Table A2: General description of studies included in the meta-analysis where the treatment group receives Buprenorphine

First author	Year	Outcome	Measure	n_{exp}	$n_{control}$	$Outcome_{exp}$	$Outcome_{control}$	Duration	Treatment experimental	Treatment control
Harris	2005	Cost of crime / any offense	Self-report (and cost attributions)	73	66	6265(2028)	13223(10209)	12 months	Buprenorphine	Methadone
Krook	2002	Commission / any offense	Self-report	51	48	96.1%[1]	99%%[1]	3 months	Buprenorphine	Placebo
Magura	2008	Arrest / any offense	Self-report	43	38	0.69(0.95)[2]	0.71(0.77)[2]	3 months post-release	Buprenorphine	Methadone

[1] The numbers given in the research are « no criminal activities » (3.9% and 1.0%
[2] mean number of arrests(sd)

Table A3: General description of studies included in the meta-analysis where the treatment group receives Methadone

First author	Year	Outcome	Measure	n_{exp}	$n_{control}$	$Outcome_{exp}$	$Outcome_{control}$	Duration	Treatment experimental	Treatment control
Daley	2000	Cost of crime / any offence	Self-report (& cost estimates)	54	183	1584.99 (15321.54)[1]	-	202 days	Methadone	Detoxification
Teesson	2006	Commission / any offence	Self-report	227	141	45%/19%	61%/27%	12 months	Methadone	Residential rehabilitation
Haglund	1978	Arrest / any offence	Self-report corroborated by official police records	130	62	39.2%/20.8 %	35.5%/	24 months	Methadone	Detoxification
Kinlock	2008	Incarceration / any offence	Self-report	68	63	13%	29%	6 months	Counselling + methadone	Counselling
Dole	1969	Incarceration / any offence	Official sources	12	16	25%	93.8%	7-10 months	Methadone	Waiting list
Bale	1980	Arrest / any offence	Self-report	59	150	49.2%	46%	12 months	Methadone	Treatment community
Newman	1979	Conviction / any offence	Unknown	50	50	1.4[2]	3.2[2]	36 months	Methadone	Placebo
Schwartz	2007	Illegal income / any offence	Self-report	199	120	416[3]	336[3]	2-10 months	Methadone	Waiting list
Yankowitz	1991	Incarceration / any offence	Known status at end of study	149	152	1.4%	0.7%	16 months	Methadone	Waiting list
Sees	2000	ASI legal / any offence	Self-report	77	57	0.05(0.13)[4]	0.13(0.193)[4]	12 months	Methadone	Detoxification

[1]Regression coefficient
[2]Conviction rate per 100 man-months of enrolment
[3]Pre-post difference of illegal income
[4]mean(sd)

Table A4: General description of studies included in the meta-analysis where the treatment group receives Naltrexone

First author	Year	Outcome	Measure	n_{exp}	$n_{control}$	$Outcome_{exp}$	$Outcome_{control}$	Duration	Treatment experimental	Treatment control
Cornish	1997	Incarceration / any offense (+ probation violation)	Return to prison (official source)	34	17	26%	56%	6 months	Counselling &Naltrexone	Counselling
Rawson	1979	Incarceration / any offense	Official source	20	15	20%	40%	12 months	Behaviour therapy & Naltrexone	Behaviour therapy