Wraparounds, Medication-Assisted Treatment, and Oregon: A Meta-Analysis

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A Meta-Analysis: In Brief

With the rise in wraparound services (also known as recovery oriented systems of care) for the treatment of substance abuse, a systematic review of these options is necessary. Likewise, medication-assisted treatment is a sub-discipline of addiction therapy that is gaining ground, but still controversial. Looking at these, as well as existing behavioral therapies, can help inform county and state officials about the potential outcomes associated with these treatments and their potential impact on other areas of concern, such as healthcare or criminal justice. In Multnomah County, these treatments are available, but not all are currently contracted with the county or being utilized to their full potential. Therefore, this report will inform policymakers and stakeholders about the treatment outcomes associated with these services, and connect them to our current local context.

Methodology

Meta-analysis is a research technique that gathers existing quantitative studies and distills its results into a single average effect size—a measure of the significance and magnitude of the studied intervention's impact. This allows researchers to easily assess what the existing literature says about a topic by comparing interventions' relative impacts, and has the potential to use that information in cost-benefit analyses and other additional research. This technique was applied to multiple wraparound services (see Table i) and medication-assisted treatment[1] across several types of outcomes, as well as to motivational interviewing, a behavioral therapy technique.

Table i: Wraparound Services Studied

Program	**Description**
Continuing Care	Care that extends beyond formal treatment
Non-Abstinent Contingent Housing	Housing to those in need, regardless of abstinence status
Abstinent-Contingent Housing	Housing where tenets must be abstinent and follow agreed upon rules
Case Management	Using a "professional ally" to manage emerging issues throughout recovery
Peer Mentoring	Pairing one who is on the road to recovery and one starting with recovery to support one another

Articles on the various treatments were collected and catalogued from 2000 to the present. Effect sizes were computed for each study, and overall effect sizes were calculated to determine the average impact an intervention had on a given outcome[2]. Outcomes included substance use, criminal justice, healthcare, employment, and treatment engagement[3]. Magnitudes of treatment impacts were then compared across various substance abuse treatments.

[1] Methadone and Suboxone were selected as a representation of pharmacological substitution therapy's.
[2] Per Lipsey and Wilson (2001), a minimum of three studies is necessary for a meta-analysis. This is the standard we utilized. Some areas in which only one or two analyzable studies were found were included for additional context, as well as brief literature reviews of non-analyzable literature.
[3] Information for every outcome may not be available for every intervention. This was due to limitations in the literature available for analysis as well time and resource constraint. Focus was targeted toward areas with the most studies or the best available outcome measures for that intervention.

Some of the benefits of a meta-analysis include the ability to condense a large amount of information down to one number, or effect size. That one effect size is standardized and can be compared to other effect sizes. Effect sizes provide a simple interpretation and direction al relationship of the effect a treatment has on a desired outcome. Additionally, meta-analysis allows us to weight studies differently based on individual study characteristics. For example, a study that lacks adequate controls and a quasi-experimental design may be weighted less than a classic experimental study or clinical trial. However, there are a few limitations to meta-analysis. In reference to weighting, it can at times be arbitrary. While there may be valid justification for weighting a study one way or another, it is nonetheless arbitrary. Meta-analysis excludes qualitative studies, which can provide both valuable outcomes and greater insight into the processes that contribute to a given outcome, positive or negative. Additionally, some quantitative studies are excluded that do not publish the necessary information to compute an effect size, even if they would otherwise be eligible. This may skew the effect size. Publication bias can also occur in a meta-analysis if all studies are peer-reviewed and published. While publication does offer a certain level of rigor, the findings in a published paper are more likely to be significant. This could potentially introduce bias into the effect size and overstate the impacts of a given treatment.

Findings

Nationally, substance abuse costs approximately $712 billion annually through a variety of means, from healthcare to incarceration costs[4]. In Oregon, approximately 21,898 individuals were receiving treatment on any given day in 2013 out of the 307,000 struggling with alcohol or illicit drug dependence[5]. Of those receiving treatment, "in a single-day count in 2013, 33.0% were in treatment for drug use only, 25.1% were in treatment for alcohol use only, and 42.0% were in treatment for both drug and alcohol use"[6]. The findings from this analysis provide evidence that a range of substance abuse treatment options, from wraparound services and medication-assisted therapies, can potentially impact the costs associated with substance abuse in a positive way.

Abstinence/Rates of Use

As the core area of concern, each intervention studied was assessed for impacts on alcohol and drug use. The service with the largest impact on the likelihood of a person being abstinent was abstinent-contingent housing. Abstinent contingent housing increased the likelihood of abstinence by 167% compared to those that are not in abstinent contingent housing. Similarly, abstinent contingent housing also had the largest impact on increasing the amount of time that a person maintains abstinence. Continuing care and non-abstinent contingent housing had a small to moderate impact on increasing the duration that a person maintains abstinence. Continuing care also increases the likelihood of a person being abstinent by 107%. On the other hand, peer mentoring generated a decrease in the likelihood of drug and alcohol use, by 32% and 23% respectively. All of these services fall under the umbrella of wraparound services. This provides evidence that wraparound services have the potential to decrease an individual's substance use and increase the amount of time a person maintains abstinence. Case management,

[4] http://www.drugabuse.gov/related-topics/trends-statistics
[5] www.samhsa.gov/data/sites/default/files/NSDUHsaeSpecificStates2013/NSDUHsaeOregon2013.pdf
[6] http://www.samhsa.gov/data/sites/default/files/State_BHBarometers_2014_2/BHBarometer-OR.pdf

methadone, Suboxone[7], and motivational interviewing found no significant relationship with substance use across the analyzed literature, although individual studies varied[8].

Healthcare

Healthcare is critically impacted by drug and alcohol use, and remains one of the most expensive indicators of addiction issues. For example, research shows that individuals that are unemployed, homeless, and disabled by chronic illness, mental illness, or battling chemical dependency often cycle between hospitals, emergency rooms, and other institutional health settings (Srebnik, 2013). Ultimately, substance abuse treatment programs can help mitigate this overutilization of ineffective healthcare services by addressing the root issue of addiction and dependence. Our findings indicate that non-abstinent contingent housing and case management have a large, and moderate to large (respectively) impact on decreasing the number of emergency room visits related to addiction and dependency. Suboxone showed no significant impact on the rate of adverse events related to addiction. While an insufficient number of studies were found to fully explore the impacts of methadone or peer mentoring via meta-analysis, the studies that were found suggested that positive impacts on decreasing hospitalizations and emergency room visits were possible from these interventions as well. The use of wraparounds directly addresses many of the social factors that contribute, while direct treatment, if successful, may help reduce or eliminate many medical conditions that result from prolonged addiction.

Criminal Justice

With the use of illicit drug being an illegal offense, there is an inherent relationship between addiction and the criminal justice system. At any given time, anywhere from 60% to 85% of inmates are struggling with addiction and dependence while incarcerated[9]. In Oregon, 71.2% of state prisoners reported addiction or some use of drugs in January 2015[10]. Meta-analytic findings indicate that the odds of being arrested while in abstinent contingent housing are decreased by 56% and methadone was found to provide a 82% decrease in the likelihood of arrest. While case management and non-abstinent contingent housing were seen to have an impact on criminal justice outcomes, the findings were inconclusive.

Employment

For some struggling with substance abuse, finding gainful employment may put them on a path to self-sufficiency and recovery. Wraparound services, particularly abstinent contingent housing, is shown to have a moderate to large impact on the likelihood of obtaining employment. Specifically, the odds of being employed in abstinent contingent housing increase by 192%. This may be due to the requirement of those utilizing abstinent contingent housing having a job. Research indicates that methadone may increase the likelihood of employment. However, our findings were unable to determine the existence of a relationship.

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[7] Suboxone and methadone had a variety of control groups that introduced bias into the analysis. More studies are needed to examine the relationship between these treatments and abstinence.

[8] No significant relationship indicates that we cannot definitively establish if a positive or negative relationship exists, apart from chance.

[9] Hiller, M. L., Knight, K., & Simpson, D. D. (1999). Prison-based substance abuse treatment, residential aftercare and recidivism. *Addiction (Abingdon, England)*, *94*(6), 833–842.

[10] http://www.oregon.gov/doc/GECO/docs/pdf/IB-53-Quick%20Facts.pdf

Treatment Engagement

Finally, case management and motivational interviewing were both found to increase the likelihood of treatment engagement, which can lead to improved outcomes over time. Suboxone was found to increase the likelihood of engagement over those using clonidine, but not more effectively than those using methadone. Motivational interviewing increases the likelihood of a patient entering treatment by 51% compared to those who do not participate in this behavioral therapy approach. The wraparound service of continuing care increased the likelihood of attending treatment by 57%. These findings indicate that a combination of treatment options may increase the odds of engaging in treatment for a longer period of time.

Table ii: Interpretation of Overall Meta-Analysis Findings

	Abstinent	**Substance Use**	**Duration of Abstinence**	**Health Outcomes**
Continuing Care	Small to Moderate (+107%)		Small to Moderate (+)	
Housing Non-Abstinent	None		Small to Moderate (+)	
Housing Abstinent	Moderate to Large (+167%)		Moderate to Large (+)	
Case Management	None		None	
Peer Mentoring		Alcohol= Very Small (-23%) Drug= Small to Moderate (-32%)		
Methadone		None		
Suboxone	None			None
Motivational Interviewing	None			
	Healthcare Utilization	**Criminal Justice Outcomes**	**Employment**	**Treatment Engagement**
Continuing Care				None
Housing Non-Abstinent	Large (-)	None		
Housing Abstinent		Small to Moderate (-56%)	Moderate to Large (+192%)	
Case Management	Moderate to Large (-)	None		Small to Moderate (57%)
Peer Mentoring				None
Methadone		Large (-82%)	None	
Suboxone				None
Motivational Interviewing				Small to Moderate (+51%)

Conclusion

The treatments explored here offer insight into the various outcomes that are possible with the implementation of wraparound services and medication-assisted therapy. By utilizing a variety of treatment approaches, a multidisciplinary approach may increase the odds of treatment success. Determining the range of needs that a person struggling with substance abuse may have will allow for the opportunity to treat substance abuse in a holistic manner.

It is important to note that there is no "silver bullet" to cure all addiction; however, an approach utilizing various services can increase the likelihood of recovery. Each of the above treatments has various strengths and weakness that, when used together, show great promise in combating drug and alcohol addiction. Utilizing a multidisciplinary and holistic approach to

treating substance abuse can build community capacity, decrease government expenditures, and set more and more people on the path to recovery from addiction and dependence.

Introduction

This technical document uses a relatively well-known statistical technique, referred to as meta-analysis or systematic review, to synthesize and standardize the body of research on several substance abuse intervention programs. The substance abuse intervention programs were chosen due to their current contract with the County, or because they are not currently contracted but represent promising new areas for consideration. Outcomes studied included substance use, criminal justice, health care utilization, and employment. These were chosen due to their relevance in the literature and their critical impact on public policy. After the available research is synthesized and standardized, this technical document attempts to place the findings in a local context by providing readers with Oregon-specific data. Ultimately, the goal of this technical document is to better inform County and State policymakers who allocate funds for substance abuse treatment options.

Additionally, it is also worth noting that the goal of this document is *not* to imply that meta-analytic results directly apply to Oregon and Multnomah County. The meta-analytic results are comprised of several studies that range in quality, populations, setting, treatment program specifics, and levels of statistical certainty. While some of these variables are explicitly accounted for in meta-analysis (e.g. statistical certainty and study quality), others are still unaccounted for (e.g. populations, setting tested, treatment program specifics, etc.). For that reason, meta-analytic results cannot be explicitly applied to Oregon. Instead, meta-analytic results are intended to serve as an extra piece of well-vetted empirical data for State and County policymakers to consider when making decisions regarding substance abuse policy. The overall results are displayed in Table 1. These results will be discussed in depth for the duration of this report.

Table 1: Complete Meta-Analysis Findings

	Abstinence			**Substance Use**			**Duration of Abstinence**			**Health Outcomes**		
	D	Log Odds	Odds Ratio	D	Log Odds	Odds Ratio	D	Log Odds	Odds Ratio	D	Log Odds	Odds Ratio
Continuing Care	0.40**	0.73**	2.07**				0.30**	0.544**	1.73**			
Housing Non-Abstinent	0.35	0.64	1.89				0.37**	0.67**	1.96**			
Housing Abstinent	0.54**	0.98**	2.67**				0.72**$_F$	1.31**$_F$	3.69**$_F$			
Case Management	0.16	0.29	1.34				0.03 (Alcohol) 0.15 (Drug)	0.05 (Alcohol) 0.27 (Drug)	1.06 (Alcohol) 1.31 (Drug)			
Peer Mentoring				-0.14* (Alcohol) -0.25** (Drug)	-0.26* (Alcohol) -0.46** (Drug)	0.77* (Alcohol) 0.63** (Drug)						
Methadone				-0.33 (Drug)	-0.6 (Drug)	0.55 (Drug)						
Suboxone	0.08	0.15	1.16							-0.4	-0.73	0.93
Motivational Interviewing	0.02	0.04	1.04									

***95% Confidence, * 90% Confidence, $_F$ indicates Fixed Effect Model*

Table 1 Cont.: Complete Meta-Analysis Findings

	Healthcare Utilization			Criminal Justice			Employment			Treatment Engagement		
	D	Log Odds	Odds Ratio	D	Log Odds	Odds Ratio	D	Log Odds	Odds Ratio	D	Log Odds	Odds Ratio
Continuing Care										-0.01	-0.02	0.98
Housing Non-Abstinent	-1.388*	-2.52*	0.08*	-0.05	-0.09	0.91						
Housing Abstinent				-0.45**	-0.82**	0.44**	0.59**	1.07**	2.92**			
Case Management	-0.53** F	-0.96** F	0.38** F	-0.2	-0.37	0.69				0.25**	0.45**	1.57**
Peer Mentoring										0.1	0.18	1.2
Methadone				-0.94*	-1.71*	0.18*	0.14	0.26	1.3			
Suboxone										0.094	0.17	1.19
Motivational Interviewing										0.23**	0.41**	1.51**

***95% Confidence, *90% Confidence, F indicates Fixed Effect Model*

Methodology

Substance abuse treatment programs are often evaluated on their ability to yield abstinence or a given duration of abstinence that is considered acceptable to policymakers. Additionally, given that substance abuse issues do not occur in a vacuum, several ancillary outcomes—ranging from a treatment program's impact on crime and employment to health care utilization—are often critical outcomes to evaluate. For that reason, the appropriation of program funds often relies on in-depth program analysis and evaluation before policymakers can justify budgeting for a certain program. Yet often, intensive original research in these subject areas isn't always possible, whether due to financial or time constraints.

Many topics of interest can be thoroughly studied via a comprehensive literature review. Anyone with access to a handful of scholarly databases can become "an expert" on nearly any academic topic. However, it is a difficult task to truly understand what an entire body of literature has to say about a single topic. In a perfect world, where one did have access to the entire body of literature on one topic, research can become extremely complex and even contradictory. Hence, "boiling down" or reducing an entire area of literature, which is often broiled in contentious disagreement, to one unified theme or conclusion is difficult. What is more, even if the literature is in agreement (e.g. treatment X increases Y), it may still be difficult to easily synthesize and standardize these findings into a helpful conclusion. This is compounded by the occasional and unfortunate tendency of academic papers to equate significance with magnitude. In other words, an intervention can be highly statistically significant and produce a positive impact, but that impact can be so small as to render it nearly meaningless when weighed against the realities of the problem at stake and the costs. Understanding, not only *statistically* significant, but also *practically* significant, outcomes, is critical when seeking to apply research to real-world scenarios.

One popular solution to this is to synthesize and standardize an area of literature. By doing this, researchers are able to boil an entire body of literature to a standardized number. Ultimately, this technique allows different areas of literature to be directly compared in an "apples to apples" approach, as well as understand the magnitude of the changes potentially rendered by these interventions.

Methods for Meta-Analysis

The following methods were used when conducting a meta-analysis on our selected set of interventions. First, scholarly articles (both published and dissertations) and white papers were located using Oregon State University online databases (e.g. Academic Search Premier, JSTOR, Web of Science), Google Scholar, and the previous analysis done by Washington State Institute for Public Policy (see http://www.wsipp.wa.gov/BenefitCost/Program/497).

Second, studies were screened to ensure that they were appropriate for meta-analysis. For instance, appropriate studies had to be quantitative, have treatment and control groups or a pre-post design, test appropriate outcomes (e.g. abstinence, emergency room visits, arrests, employment, etc.) and provide enough data[11] for a standardized measure of effect, otherwise known as an effect size, to be calculated. All effect size calculations were done with the "Practical Meta-Analysis Effect Size Calculator," which is available online through George Mason University[12].

Third, effect sizes were calculated for appropriate studies. Odds ratios were created for binary outcomes (e.g. employed or not, etc.) and Cohen's D was calculated for continuous outcomes (e.g. number of weeks sober, etc.). At this point, individual studies are directly comparable to one another. However, it should be noted that effect sizes were not calculated for each treatment and outcome. There were some outcomes for given treatments that were not calculated. This was due to practicality (e.g. the given outcome wasn't relevant for the treatment), or due to a lack of literature on the outcome.

Fourth, studies were coded and weighted for potential quality biases, where "unbiased" studies were multiplied by a factor of one (remaining the same) and "potentially biased" studies were multiplied by a factor less than one, to reduce their effect. However, it is important to note that the weighting was not applied to individual studies' effect sizes, but was used to calculate the overall effect size. Additionally, to mitigate statistical issues for bias, odds ratios were converted to logged odds for analysis. Likewise, if the sample size was very small, the Cohen's D was adjusted with Hedges' G to mitigate upward bias.

Fifth, a fixed effects model was calculated, whereby a study's weighted effect size was multiplied by its inverse variance (w). Inverse variance weighting (w) is important when calculating the overall effect size. This is because studies collected for this meta-analysis had different sample sizes. Studies with "big" sample sizes are considered more precise—given that they have small standard errors. Conversely, studies with "small" sample sizes are considered less precise, due to their larger standard errors. For that reason, meta-analysis gives larger studies more weight than smaller studies. Graphically, this means that more precise studies with relatively small confidence intervals (short lines in the forest plot) are weighted more than less precise studies with relatively large confidence intervals (long lines in the forest plot)[13] when determining overall effect sizes. While this can be done via sample size weighting, the preferred process in meta-analysis is to weight via the inverse of the variance (otherwise known as the inverse of a standard error). Hence, studies with a large sample size will have smaller variances (and smaller standard errors), which equates to a larger inverse variance weight (w); while studies with a small sample size will have a larger variance, which equates to a smaller inverse

[11] Necessary data includes sample size (all effect sizes), means and standard deviations/errors (Cohen's D), proportions of success/failure (odds ratio), etc.

[12] http://cebcp.org/practical-meta-analysis-effect-size-calculator/

[13] See Figure 13 and 14. One study is non-significant while two are significant; yet, the overall effect size is not significant. This is because the one non-significant study carries a lot more weight than the two studies that are significantly positive.

variance weight (w). After each weighted study was multiplied by its inverse variance, an overall fixed effect size (the average effect size) was calculated. At this point, an entire body of literature is reduced to a single standardized number—an average fixed effect size, taking into account all magnitudes of effect and varying significances.

Sixth, a random effects model was also used to calculate the overall effect size. Random effects models are used to mitigate issues with sample heterogeneity between study effect sizes. Hence, a random effects model assumes that study effect size variability is due to sampling error *plus* true differences between studies—like population or study design differences—while a fixed effects model[14] assumes the only differences between studies are the result of sampling error. Thus, the random effects model mitigates the issue of heterogeneity between studies by providing researchers with a more conservative estimate of overall effect size.

Meta-analytic results were then presented graphically, at the 90% level of significance, with forest plots. These forest plots contained each study's individual effect size, as well as random effects and fixed effects overall effect sizes. There were two types of forest plots created based on the type of effect size that was calculated. For dichotomous outcomes, logged odds were depicted in forest plots. For continuous outcomes, Cohen's D was depicted in forest plots.

Last, in order to express magnitude, dichotomous outcomes were interpreted with random effects odds ratios, percent changes, and an equivalent Cohen's D. Continuous outcomes were interpreted with the random effects Cohen's D. However, these interpretation of Cohen's D were made simpler by categorizing D's as either very small, small to moderate, moderate to large, or large. The significance of these interpretations, at either 90% (*) or 95% (**) significance, is also noted alongside these interpretations. All interpretation of magnitude relies on the random effects model unless otherwise noted ($_F$).

Weighting Criteria

As previously mentioned, appropriate studies were coded and weighted for potential biases[15]. This weighting was conducted in several steps. First, studies were coded based on: author affiliation, study design, and outcome measurement. Problematic studies included those without a single "outside author" (e.g. a study where all of the authors were affiliated with the program being studied), studies with a quasi-experimental design *and* no adequate controls, and studies that relied on *only* self-report data for treatment outcomes, with no alternative objective measurement. Second, after studies were coded, the number of potential issues per study was tallied up (one, two, or three potential biases). Studies were then penalized by .1 for each issue using the following equation: weight=1-(number of issues*0.1). Hence, a study with no issues had a weight of 1, while a study with one issue had a weight of 0.9.

Cohen's D Effect Size

Cohen's D is a simple standardized measure of effect, which can be used to understand relative magnitude and direction of a relationship. The equation for Cohen's D is:

$$D=\frac{\bar{X}_T-\bar{X}_C}{S}$$

[14] Fixed effect models are appropriate for a meta-analysis of replication studies (e.g. studies that replicate each other in terms of population, study design, etc. and therefore have no differences other than sampling error).
[15] This custom was derived from a similar method conducted by the WSIPP study.

It is the difference between the treatment and control means, divided by the average standard deviation. This standardized measure is predicated on means and standard deviations—the effect size measures the difference, in standard deviations, between two means. Accordingly, a Cohen's D of 0.2 indicates that the difference between the treatment group and control group averages is 0.2 of one standard deviation.

However, these interpretations of effect are not overly clear or user-friendly. Instead, to allow for simple interpretation of magnitude, Cohen's D is commonly categorized as follows: 0.2 or less indicates a small effect, 0.5 indicates a moderate effect, and 0.8 or larger indicates a large effect. Cohen's D is always interpreted as an absolute value (Lipsey & Wilson, 2001).

Table 2: Cohen's D Estimated Impact Interpretations of Magnitude

Estimated Effect	Cohen's D
Large	0.8+
Moderate to Large	0.5 - 0.8
Small to Moderate	0.2 - 0.5
Very Small	< 0.2

However, the calculation of a Cohen's D can yield negative effect sizes (e.g. D= -0.2). Accordingly, a negative effect size simply indicates that the mean for the treatment group is less than the mean for the control group. For example, in an analysis of "number of emergency department visits," a negative effect size (e.g. D= -0.5) simply indicates that the average number of emergency department visits for the treatment group is less than that of the control group. Conversely, a positive effect size indicates that the mean number of emergency department visits is greater for the treatment group than the control group. Ultimately, these differences are analyzed in absolute terms (e.g. 0.5), which, as the above table shows, is a moderate effect size. In the case of the negative Cohen's D, we would report that the treatment group has a moderate effect size for *reducing* the number of emergency department visits (since the average number of visits for this group is less than that of the control group); while, for the positive effect size, we would report that the treatment group has a moderate effect size for *increasing* the number of emergency department visits (since the average number of visits for this group is more than that of the control group).

Odds Ratio Effect Size

The odds ratio is the second effect size that is used in this meta-analysis. Unlike the Cohen's D, which is typically used for continuous outcomes (e.g. number of emergency department visits), the odds ratio is meant for interpreting the magnitude and direction of dichotomous outcomes and a given treatment (e.g. arrested or not; sober or not). The equation for the odds ratio is based, first, on the odds of an event.

Odds of an event=Probability/(1-Probability),

If the probability of an event occurring is ¼ (or 0.25) for the treatment group, then the odds of being abstinent equal 0.33 [0.33=0.25/(1-0.25)]. Likewise, if the odds of being abstinent in the control group are 1/5, or 0.20, then the odds of being abstinent in the control group are 0.25. Ultimately, the odds ratio is calculated by taking the ratio of these odds—which, in this case, is 0.33/0.25. This would result in an odds ratio of 1.33. Its effect would be interpreted as:

the odds of abstinence, for those in the treatment group, are 1.33 times of that relative to the control group, or 33% greater (Lipsey & Wilson, 2001).

Log Odds Effect Size

While odds ratios are the preferred effect size when dealing with dichotomous outcomes, logged odds ratios—which are the natural log of an odds ratio— are typically used for meta-analysis. This is due to three reasons. First, log odds allow for a (mostly) normal distribution—which is necessary for this statistical technique. Second, log odds make graphical interpretation easier than odds ratios. Hence, as our figures will later show, a negative log odd signifies a negative relationship between treatment and outcome, while a positive log odd signifies a positive relationship between treatment and outcome. This also means that the threshold for significance is 0 with a log odds effect size[16]. In other words, if an effect size crosses zero in our figures, the outcome is non-significant. Third, log odds allow for a simple conversion back to an odds ratio—which is convenient for those who prefer the interpretation of the aforementioned odds ratio (Lipsey & Wilson, 2001). Thus, logged odds allow this statistical technique to be conducted, given their normal distribution. What is more, they simplify graphs and statistical significance. What is more, they also allow for an easy conversion back to odds ratios when further interpretation of magnitude is desired.

Summary

The previous three effect sizes can be applied to several substance abuse treatment outcomes of interest. As was previously mentioned, meta-analysis is helpful for synthesizing numerous studies and creating standardized measures of effect. For example, with an overall effect size, the researcher can make a claim that says: across all studies surveyed, those receiving abstinent contingent housing are 2.67 times (167%) more likely to be abstinent than the control groups.

This is valuable information as it shows the relative impact that this treatment has on the odds of abstinence, when compared to control groups. However, as the above table shows, effect sizes are most valuable for their ability to compare *across* treatments. This allows researchers to say something more than just "abstinent contingent housing and continuing care are both associated with increases in the odds of abstinence". Using overall effect sizes, we can say: "research suggests that abstinent contingent housing has the largest impact on the odds of abstinence when compared to other treatment options. More specifically, abstinent contingent housing (odds ratio = 2.67; percent change=167%), and continuing care (odds ratio = 2.07; percent change=107%) both increase the odds of abstinence by a factor of at least 2, relative to those in the control groups—with the former having a slightly larger impact on increasing the odds of abstinence than the latter[17]."

Another benefit of these effect sizes is the easy conversion between Cohen's D, odds ratios, and log odds. As the same table shows, each effect size can be calculated for these treatments. For instance, once an odds ratio was calculated for abstinence, the natural log (e.g.

[16] This is not the case with odds ratios, which use 1 as a cut off for significance. Likewise, odds ratios cannot be negative, so a number than is less than 1, but greater than 0, is what signifies a negative relationship.

[17] Of course, there are more factors (e.g. relative cost, the Oregon context, substance abuse programs in combination with other treatment options, etc.) than relative impact to consider when weighing different interventions, which will be discussed further on in this paper

log odds) is easily calculable. Additionally, log odds are relatively simple to convert to Cohen's D. All conversions in this analysis were done with the following equation:

$$Cohen's\ D = Log\ Odd \times 3/\Pi$$

Each of these three effect sizes serves a purpose for understanding the relationship between a treatment and an outcome. Hence, Cohen's D is useful for simple interpretation of magnitude, odds ratios are necessary for understanding multiplicative/percent changes, while log odds are useful for examining the direction of a relationship.

Confidence Intervals

Each effect size has a corresponding confidence interval. A confidence interval is essentially a measure of statistical certainty. This degree of certainty can be measured by the size of the confidence interval. Most analysis relies on either a 90% or 95% confidence interval. This analysis reports both. A 95% confidence interval indicates that 95 times out of 100, the 'true coefficient' falls within this specific range. Likewise, a 90% confidence interval means that 90 times out of 100, the 'true coefficient' falls within this range. Therefore, if a confidence interval does not cross over from negative to positive, or vice versa, the outcome is considered significant at that level—the result is positive or negative 90 or 95 percent of the time, even though the magnitude may vary.

This level of certainty allows researchers to calculate statistical significance (the likelihood that the effect did not occur by chance). The intervals are considered statistically significant if they do not contain a zero for Cohen's D and log odds effect sizes, or contain a 1 for odds ratio effect sizes; in other words, the potential range of results do not include both positive and negative impacts. Occasionally, throughout this analysis, effect sizes are noted as significant at the 95% confidence level. This means that findings have stronger significance than those at the 90% level.

Wraparounds: Overview

Wraparounds, also frequently known as recovery support services, are supportive services that do not directly treat addictions. For instance, wraparound services can range from housing programs (e.g. Housing First or Oxford Homes) to case management. Wraparounds complement traditional treatment options by providing a wide array of services to individuals with substance use and addiction issues. These programs work holistically to develop and grow all aspects of a person's life, not only the singular issue of drug abuse. Multnomah County funds several ancillary treatment options for selected providers, who provide services for individuals who meet certain income criteria. Generally, this population is the uninsured and Medicaid populations. The County provides funds for housing, case management, continuing care, and peer mentoring services via community providers, albeit in varying amounts. With the increase of funds available for these programs in the wake of the Medicaid expansion and the increased emphasis on long-term recovery, it seemed an apt time to further investigate their usefulness as supplements to traditional treatment options.

Medication-Assisted Therapy: Overview

Medication-assisted therapy, also known as pharmacological substitution therapy, is a relatively new set of treatment options when it comes to treating substance abuse. This therapy involves the utilization of other drugs to assist with detoxification and wean a person off of an illicit drug, generally opioids, safely over a period of time. These medications can reduce or eliminate withdrawal symptoms and help reduce cravings. While there are a variety of medications that can be utilized, methadone is the most common. Additionally, Suboxone is quickly becoming widely utilized, despite the increase cost associated with it. Within Multnomah County, two programs that utilize methadone maintenance are currently given support. As of now, no Suboxone clinics are provided with funding from the county.

Wraparounds: Continuing Care

Continuing care is a form of wraparound service that attempts to extend initial episodes of care (McKay, 2014). Hence, given that substance abuse issues are considered a long-term chronic battle, continuing care attempts to provide a more enduring option for treatment to those with substance abuse issues (McKay, 2014; Hubbard, 2007; Godley, 2010). These forms of treatment include the popular telephone-counseling treatment option, in addition to other forms of continuing care such as Assertive Continuing Care (Godley, 2002) and Reinforcement Based Therapy (Jones, 2005). While these programs do vary between one another (e.g. the former telephone care is based on over-the-phone contact, while the latter are based on a Community Reinforcement Approach; some forms take place during treatment to reinforce retention, while others fall into what is often called “aftercare”), they all share the common long-term approach for combating chronic substance abuse issues.

Surveyed literature overwhelmingly highlights the wide array of benefits resulting from continuing care. These benefits of continuing care include “better outcomes” for those in treatment, such as reductions in drug/alcohol use (Godley, 2002; Mckay 2005, 2014; Jones, 2005; Brown, 2004; Dennis, 2003; and Ritsher, 2002) and higher engagement/less need for future treatment (Dennis, 2003; Scott, 2005). What is more, additional research has shown that there is a significant positive relationship between the *amount* of continuing care one receives, and the magnitude of the resulting positive outcome (Cacciolla, 2008). For these reasons, continuing care literature characterizes this treatment option as a promising approach for combating substance abuse issues.

Methods

Articles for continuing care were located via searches in the Oregon State University article databases and Google Scholar. The keywords used for searches paired substance/drug/alcohol abuse with: “continuing care”, “aftercare”, and “telephone counseling”. After reviewing these databases, 18 studies were initially chosen for analysis. Studies were initially chosen if they were quantitative, had a control and treatment group or a pre-post design, and if they were published after the year 2000. After a closer review, which examined studies to see if they had published the necessary data to calculate an effect size, 11 of the 18 collected studies were found to be appropriate for meta-analysis.

Results

Of the 11 studies that fit the criteria for analysis, three treatment outcomes (abstinence, duration of abstinence, and treatment engagement) are identified in the studies. Information for healthcare utilization, employment, and crime outcomes are not found in these studies and is, therefore, not available in this analysis. The overall effect sizes in Table 3 are presented in equivalent Cohen's D, log odds, and odds ratio form.

Table 3: Summary of Effect Size Results

Parameter	Number of Studies	D	Log Odds	Odds Ratio
All Studies	11		--	--
Substance Use Outcomes				
Abstinence	9	.40**	.73**	2.07**
Duration of Abstinence	5	.30**	.54**	1.73**
Treatment Engagement # Treatment Visits	4	-.01	-.02	.08

*** Indicates 95% Confidence; * Indicates 90% Confidence; $_F$ indicates a fixed effects model*

Abstinence

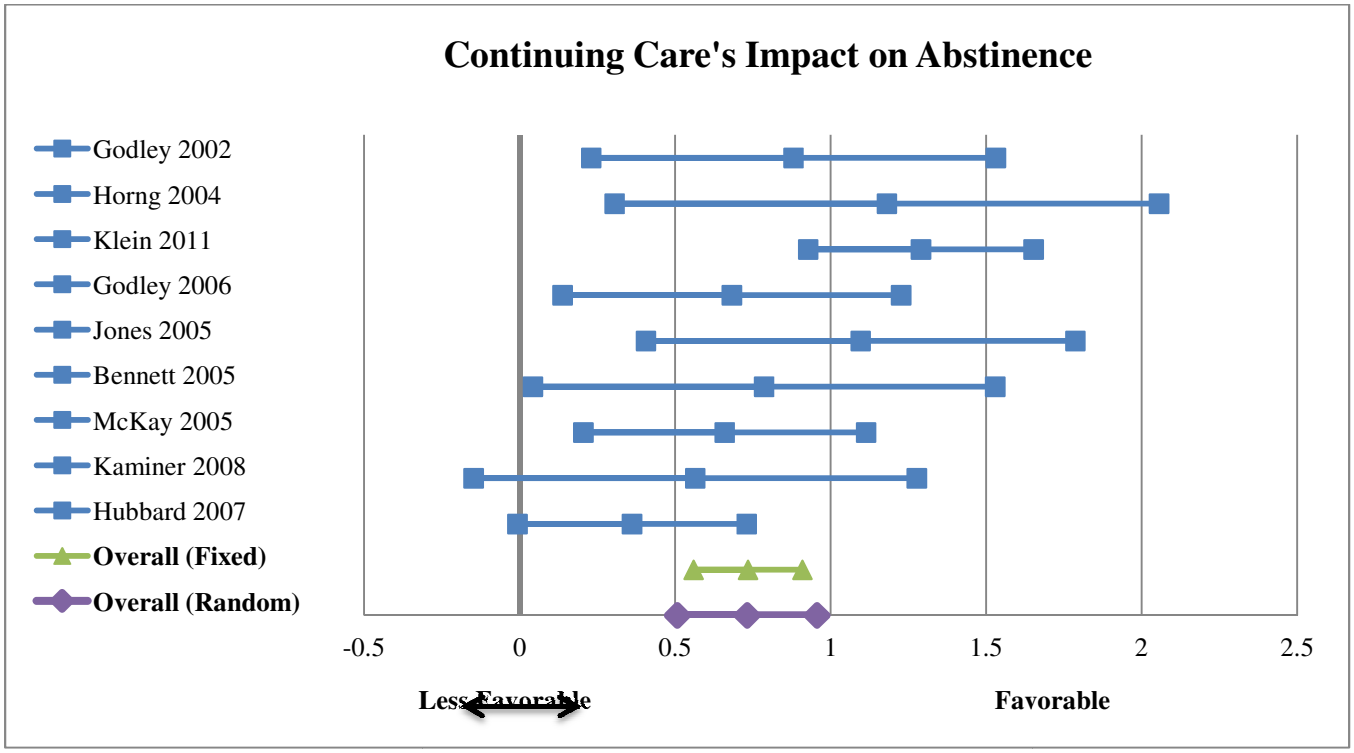
Nine studies measure the impact of continuing care on a dichotomous measure of abstinence (was the client abstinent or not at follow-up). Abstinence outcomes are a combination of alcohol, drug, and total (drug and alcohol) abstinence. This and further information is presented in Table 4.

Table 4: Study Characteristics with 'Abstinence' Outcome

Primary Author Last Name	Year Published	Follow-up Duration after Beginning Treatment	Total Sample Size (N)	Type of Abstinence Use Measured	Treatment Group	Control Group
Godley	2005	9 Months	176	Drug	Assertive Continuing Care	Usual Continuing Care
Jones	2005	3 Months	130	Drug	Reinforcement Based Therapy	Usual Care
Bennett	2005	End of Treatment	116	Alcohol	Relapse Prevention Training	Standard Care
McKay	2005	24 Months	224	Total	Telephone	Standard Continuing Care
Kaminer	2008	End of Treatment	121	Drug	Aftercare	No Aftercare
Hubbard	2007	N/A	324	Drug	Telephone	Standard Care
Klein	2011	6 Months	849	Total	Highly Adherent to Continuing Care	Little Adherence to Continuing Care
Horng	2004	3 Months	77	Total	Continuing Care	Usual Care
Godley	2002	3 Months	114	Total	Assertive Continuing Care	Usual Continuing Care

Figure 1 displays the effect size of each study in Log Odds format with the 90% confidence interval surrounding it. Seven studies have a statistically significant positive relationship between continuing care and abstinence (favorable towards the continuing care) and no studies have a significant negative relationship.

Figure 1: Log Odds Effect Sizes for the 'Abstinence' Outcome



Using log odds, it is clear in Figure 1 that the overall effect size shows a relationship between continuing care and likelihood of abstinence that is positive and significant. Further interpretation of these log odds can be expressed with an equivalent odds ratio and Cohen's D. The overall effect size, OR= 2.07**, means that across all the selected studies, the odds of abstinence for those in continuing care are 2.07 times that (107%) of those in control groups. This translates to continuing care having a small to moderate effect size (D=.40**) for increasing abstinence, when compared to control groups. In other words, the literature synthesized and standardized in this meta-analysis suggests that continuing care has better abstinence outcomes than usual care, treatment as usual, etc., although outcomes do vary between individual studies.

Duration of Abstinence

This was used as a proxy for a continuous measure, like level of use. We couldn't find a consistent continuous measure of level of use, like liters of alcohol consumed in a week, so we utilized this outcome, hoping that it would be more insightful than just "abstinent or not." We realize that complete abstinence for those with addiction issues is difficult, so we hoped that a variable, which measured the length of time someone was abstinent, would be appropriate.

Five studies include outcome variables that measure the impact of continuing care on the duration of abstinence that individuals were able to attain. This measurement captures the percent of days abstinent following treatment. The total sample size of these studies ranges from 81 to 849. This, and further information, is recorded in Table 5.

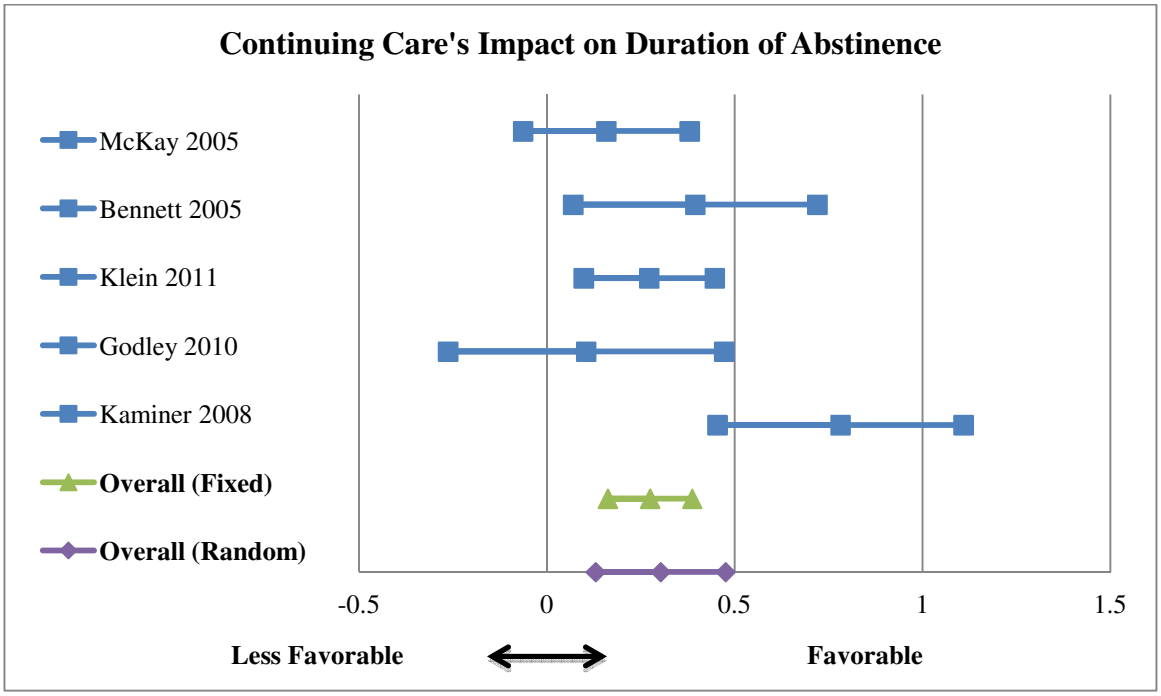
Table 5: Study Characteristics with 'Duration of Abstinence' Outcome

Primary Author Last Name	Year Published	Level of Abstinence Measured	Total Sample Size	Treatment Group	Control Group
Klein	2011	Percent of Days Abstinent	849	Highly Adherent to Continuing Care	Little Adherence to Continuing Care
Godley	2010	Percent of Days Abstinent	81	Telephone	Usual Continuing Care
Kaminer	2008	Percent of Days Abstinent	121	Aftercare	No Aftercare
Bennett	2005	Percent of Days Abstinent	105	Relapse Prevention Training	Standard Care
McKay	2005	Percent of Days Abstinent	224	Telephone	Standard Care

Figure 2 depicts the effect sizes for each study as well as the overall effect size[18] derived from the fixed and random effect models. Three studies show a significant positive treatment impact of continuing care on duration of abstinence, while two fail to show a significant relationship.

[18] Only one study (Bennett, 2005) was weighted at 0.9 or 90% due to study design. Bennett (2005) failed to have any outside authorship for this study. A second study (Klein, 2011) was weighted at 0.8 due to the reliance on only self-report data and the use of a quasi-experimental study design without adequate controls.

Figure 2: Cohen's D Effect Sizes for the 'Duration of Abstinence' Outcome



Using Cohen's D, it is clear in Figure 2 that the overall effect size shows a small to moderate positive relationship (D=0.30**) between continuing care and duration of abstinence that is significant. The analyzed literature suggests that continuing care is better at increasing the duration of abstinence than usual care, treatment as usual, etc., although outcomes do vary between individual studies.

Treatment Engagement (Number of Sessions Attended)

Four studies report whether continuing care has an impact on treatment attendance—in this case, treatment attendance was measured as the number of treatment sessions attended. The sample sizes of all four studies range from 104 to 339 participants. Study characteristics for these studies are in Table 6.

Table 6: Study Characteristics for 'Treatment Engagement (# Sessions Attended)'

Primary Author Last Name	Year Published	Total Sample Size	Outcome Measured	Treatment Group	Control Group
Mckay	2014	193	Sessions Attended	Telephone	Treatment as Usual
Godley	2010	104	Sessions Attended	Telephone	Usual Continuing Care
Hubbard	2007	339	Documented Attendance (#)	Telephone	Standard Care
Mckay	2005	224	Sessions Attended	Telephone	Standard Care

Effect sizes for each study are computed, as well as an overall effect size[19] with fixed and random effects. The effect sizes are depicted in Figure 3. One study has a statistically significant negative relationship between continuing care and treatment engagement, while one study has a statistically significant positive relationship. The other two studies are shown to have no statistically significant relationship between continuing care and treatment engagement.

Figure 3: Cohen's D Effect Sizes for the 'Treatment Engagement (# Sessions)' Outcome

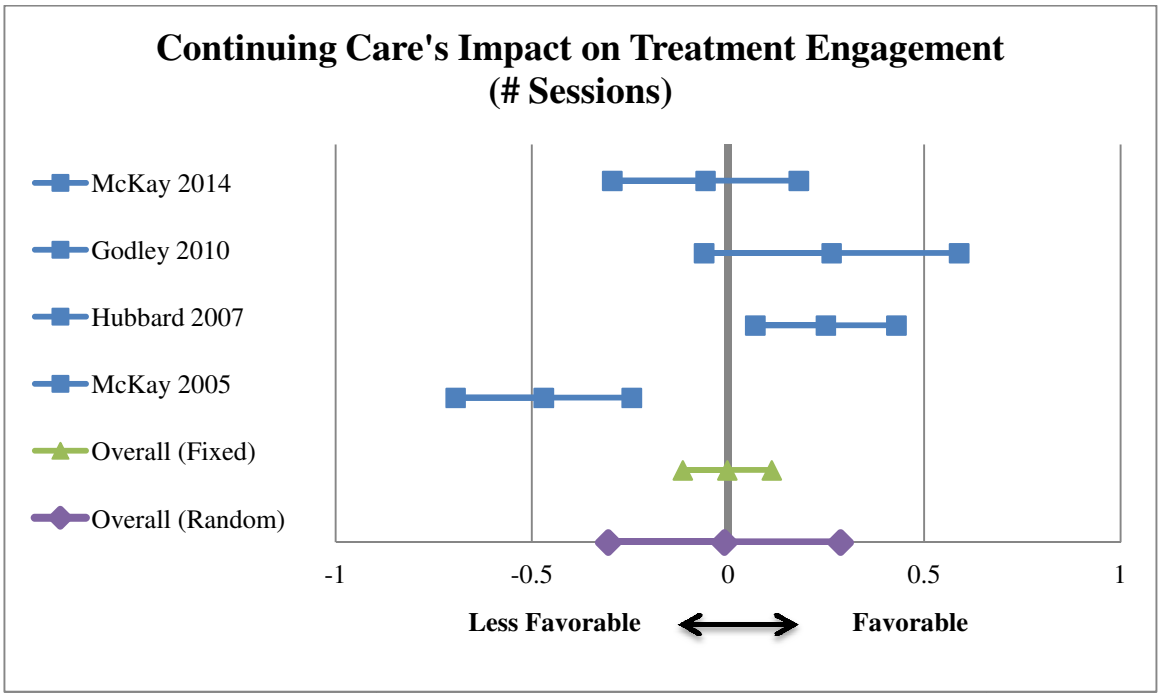


Figure 3 illustrates that the overall effect shows no significant relationship between continuing care and treatment engagement. In other words, the literature synthesized and standardized in this meta-analysis does not suggest that continuing care is any better or worse at increasing the number of treatment sessions attended than usual care, treatment as usual, etc., although outcomes do vary between individual studies and the small number of studies suggests that further investigation into this area could be useful.

Conclusion

Overall, a meta-analysis examining the impact of continuing care is mixed. Continuing care has better abstinence (small to moderate) and duration of abstinence outcomes (small to moderate) than control groups. Yet, continuing care does not seem to have better treatment engagement outcomes than control groups. Information for healthcare outcomes, employment, and crime outcomes were not available in the included studies for analysis.

When compared to other wraparound and medication assisted treatments, continuing care outcomes do not appear to have as large of a magnitude of effect as other options studied. In other words, even though continuing care has desirable impacts on public policy, there appear to

[19] All studies were weighted by a factor of 1 due to the lack of researcher-identified issues.

be treatment options in this document with "larger" impacts on abstinence and the duration of abstinence than continuing care. Yet, this relative difference in magnitude of effect may be offset by the fact that continuing care is generally regarded as one of the cheapest wraparound options to fund.

Meta-analytic results can be powerful in generating research conclusions. However, all results should be interpreted carefully and with plenty of caveats. For instance, before continuing care can be fully understood, further research may be required. Hence, qualitative studies should be explicitly explored for continuing care to ensure that researchers aren't missing any important data for this wraparound option. While the addition of qualitative research could impact all of our meta-analytic findings, it seems that continuing care outcomes could be impacted the most. For instance, meta-analysis concluded that there was no differential impact of continuing care on treatment engagement, relative to control groups. However, it is entirely possible that the inclusion of interviews with continuing care service providers who have intimate knowledge of the impact of this program, like telephone counselors, could significantly change our conclusions—especially if research shows a reoccurring theme of telephone counselors describing instances in which treatment engagement significantly increased following their sessions. For that reason, given the potential for rich detail that is excluded in this meta-analysis, our results must be considered with this caveat in place.

Wraparounds: Non-Abstinent Housing

Non-abstinent contingent housing is a form of wraparound service that break down barriers to sobriety and offers residents housing, regardless of their current drug and alcohol habits (Srebnik, 2013; Tsemberis, 2004; Padgett, 2006). Ultimately, these types of homes highlight the belief that housing is a basic right, and the highest priority for aiding a patient's recovery from substance abuse issues (Padgett, 2006). Yet, the program doesn't end at housing. While housing is automatically provided to those who desire it, treatment offered by professional staff is also available to those housed clients who choose it (Tsemberis, 2004). What is more, eviction within the Housing First program is seen as a last resort (Srebnik, 2013).

Overall, the surveyed literature shows that non-abstinent contingent housing, although not completely established, is gaining momentum as a viable substance abuse treatment solution (Padgett, 2006 & 2010; Groton, 2013). However, this finding appears to be mostly predicted on non-abstinent contingent housing reducing external service utilization, such as emergency healthcare (Martinez, 2009; Sadowiski, 2009; Larimer, 2009; Tsemberis, 2004), and keeping residents engaged and housed, as opposed to its direct impact on abstinence—which appears to be analyzed far less among researchers. Likewise, these trends in the literature can be seen via the forthcoming meta-analysis, which is only able to recover four studies that analyzed the impact of treatment on abstinence (Milby, 2005; Broner, 2009; Padgett, 2006; Padgett, 2010). For comparison, the three other treatments studied all have about twice as much available literature on this outcome.

Similarly, literature collected in a research note by Groton (2013) synthesizes several notable Housing First studies. Most of these studies, as Groton (2013) summarizes, show that Housing First is a relatively promising, yet not anywhere near perfect, treatment option for substance abuse. For instance, Tsai (2010) found that Housing First significantly increases time being housed and has better treatment outcomes (Stefancic, 2007). However, Groton (2013) does note that most substance abuse and mental health outcomes appeare to stay constant between

Housing First and non-housing groups, meaning that there doesn't appear to be a significant impact of this program on these outcome areas (Collins, 2012; Tsai, 2010; Pearson, 2009; Stefanic, 2007; Greenwood, 2005; Tsemberis, 2004). However, there are some studies that, rather than examine abstinence, operate from a harm reduction stance—that reducing use, even if not eliminating, is still a desirable outcome. The literature on reduction is still mixed as well—while a number of studies, particularly those examining alcohol usage, note decreases (Padgett, 2011; Collins, 2012a; Collins, 2012b; Larimer, 2009; Campbell, 2014), a number of others note no change. It should be recognized, however, that no negative results—that Housing First models *increase* substance use—have been found, disproving the idea that such an arrangement may enable substance users in their addiction.

Methods

Articles for the non-abstinent contingent housing were located via searches in the Oregon State University article databases and Google Scholar. The keywords used for searches paired substance/drug/alcohol abuse with "Housing First model," "non-abstinent contingent housing," "housing non-abstinent," and "housing substance abuse." After reviewing[20] these databases, 15 studies were initially chosen for analysis. Studies were initially chosen if they were quantitative, had a control and treatment group, and if they were published after the year 2000. After a closer review, which examined studies to see if they had published the necessary data to calculate an effect size[21], 12 of the 15 collected studies were found appropriate for meta-analysis.

Results

Of the 12 studies that fit the criteria for analysis, four treatment outcomes (abstinence, duration of abstinence, healthcare utilization, crime) are identified in the studies. Employment, healthcare utilization, and treatment engagement do not contain appropriate studies for analysis. For that reason, they are excluded from this analysis.[22] The overall effect sizes in Table 7 are presented in Cohen's D, log odds, and odds ratio form.

[20] Review used saturation as an end point (e.g. review is complete if the same papers keep showing up with different keywords, in different databases, etc.).

[21] Effect size calculation requires very specific data (e.g. sample sizes; standard deviations/errors; means; proportions; etc.). However, before eliminating a paper from the meta-analysis, we made every attempt to calculate the necessary data for meta-analysis (e.g. if it was possible, given the data provided, we would calculate proportions, means, standard errors, etc.)

[22] This does not mean, however, that these outcomes are unaffected by non-abstinent contingent housing.

Table 7: Summary of Effect Size Results

Parameter	Number of Studies	D	Log Odds	Odds Ratio
All Studies	12		--	--
Substance Use Outcomes				
Abstinence	4	.35	.64	1.89
Duration of Abstinence	3	.37**	.67**	1.96**
Healthcare Utilization Outcomes				
# ED Visits	5	-1.388*	-2.52*	.08*
Criminal Justice Outcomes				
# Days Jailed	3	-.05	-.09	.91
Employment				
Employed	2	$.15_F$	$.27_F$	1.31_F

*** Indicates 95% Confidence; * Indicates 90% Confidence; $_F$ indicates a fixed effects model*

Abstinence

Four studies measure the impact of non-abstinent contingent housing on a dichotomous measure of abstinence. Abstinence outcomes are a combination of alcohol, drug, and total abstinence. This, and further study information, is recorded in Table 8.

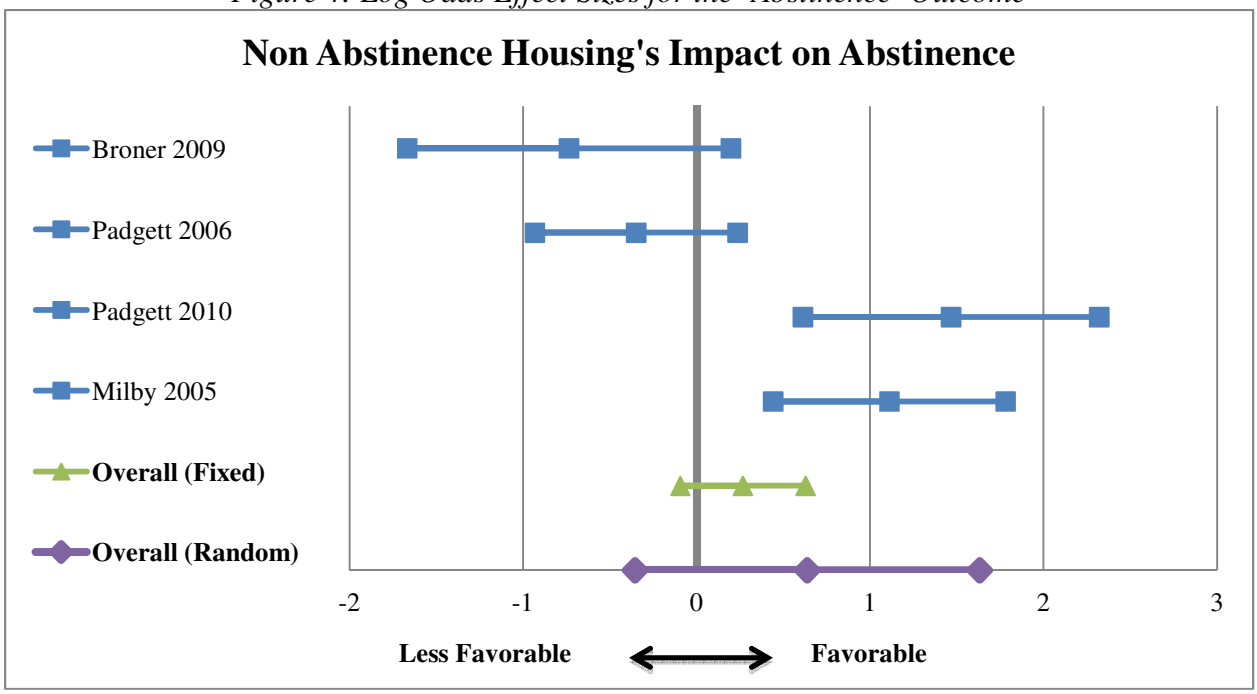
Table 8: Study Characteristics with 'Abstinent' Outcome

Primary Author Last Name	Year Published	Follow-up Duration after Beginning Treatment	Total Sample Size (N)	Type of Abstinence Use Measured	Treatment Group	Control Group
Milby	2005	6 Months	133	Drug	Non-Abstinent Contingent Housing	No Housing
Padgett	2010	12 Months	75	Total	Housing First	Treatment First
Padgett	2006	48 Months	225	Drug	Housing First	Usual Care
Broner	2009	12 Months	589	Drug	Non-Abstinent Contingent Housing	Usual Care

An effect size for each study is computed, as well as an overall effect size measuring the impact of non-abstinent contingent housing on the odds of abstinence. Figure 4 displays the effect size of each study in log odds format with the confidence interval surrounding it.

The overall effect size[23] is displayed with a fixed effect model and random effects model. Ultimately, Figure 4 shows that two of the studies were not statistically significant. The other two studies have a statistically significant positive relationship between non-abstinent contingent housing and abstinence (favorable towards the non-abstinent contingent housing intervention).

Figure 4: Log Odds Effect Sizes for the 'Abstinence' Outcome



As Figure 4 shows, the overall effect size is not significant. The literature synthesized and standardized in this meta-analysis does not suggest that non-abstinent contingent housing is any better or worse at achieving abstinence than usual care, treatment as usual, etc., although outcomes do vary between individual studies.

Ultimately, when given additional context and literature on this topic, these results are not overly surprising. This could be due to two reasons. First, non-abstinent contingent housing may not have an impact on abstinence. Recall that most research was centered on outcomes aside from abstinence (only four studies were used in this abstinence meta-analysis). For that reason, compared to the three other treatments studied, non-abstinent contingent housing is relatively understudied in this outcome area. An obvious reason for this could be the apparent lack of an impact of this treatment on abstinence—which could explain why researchers aren't committing time on the outcome (Groton, 2013; Collins, 2012; Tsai, 2010; Pearson, 2009; Stefanic, 2007; Greenwood, 2005; Tsemberis, 2004). Second, this could be the wrong indication of this outcome. In other words, a dichotomous measure of abstinence may not be an appropriate outcome for this treatment option, considering the institutional structure of these homes, which don't require abstinence and are often tailored toward individuals with more severe addiction and mental health comorbidity. Better measures may examine harm reduction, or other areas of the type

[23] These three studies' effect sizes were adjusted to .9 due to the quasi-experimental design without adequate controls (Padgett, 2010; Broner, 2009) and reliance on only self-report data (Padgett, 2006).

included in this analysis (health, etc.). Thus, regardless of the specific reason, the lack of meta-analytic significance does not appear overly surprising, given its context.

Duration of Abstinence

Three studies include outcome variables that measure the impact of non-abstinent contingent housing on the duration of abstinence that residents are able to attain. This measurement intends to be more realistic for individuals battling substance abuse than complete abstinence. Hence, the duration of abstinence outcome captures the number of days or weeks abstinent while in treatment--in other words, an outcome attempting to measure the degree or level in which residents are able to stop drug and alcohol use, as opposed to a resident fully cutting all drug and alcohol use.

The total sample size of these studies ranges from 68 to 225, and duration of abstinence was reported in several different ways. However, it was determined that the outcomes were similar enough for a meta-analysis to be conducted, given that each outcome measured the time (e.g. days, weeks, months, etc.) a resident was abstaining from drug or alcohol use. This, and further information, is recorded in Table 9.

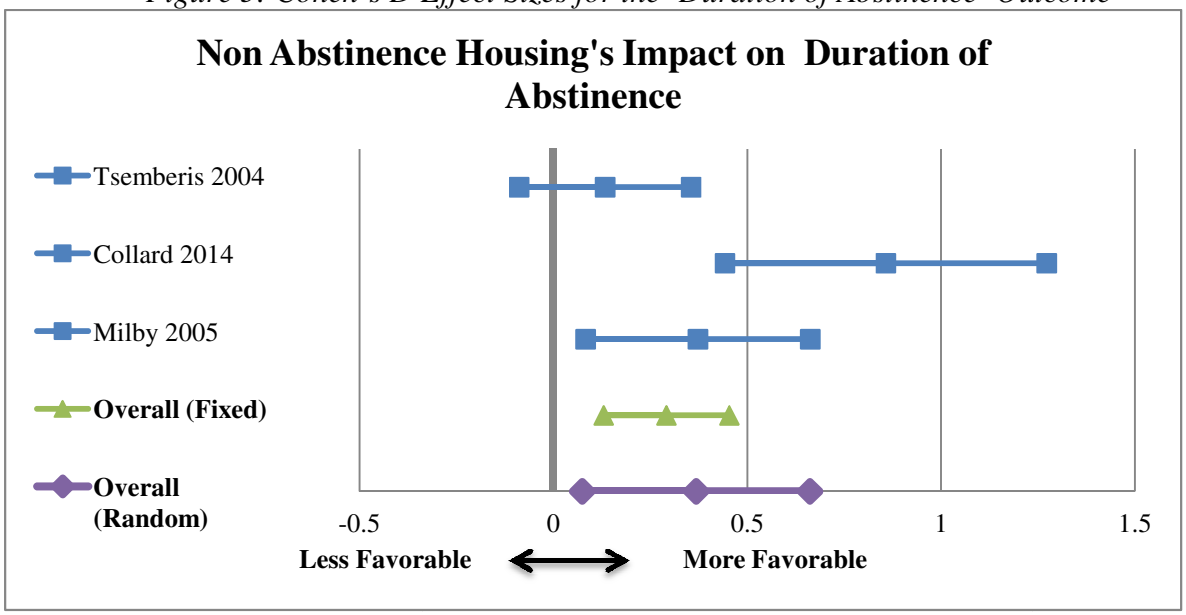
Table 9: Study Characteristics with 'Duration of Abstinence Outcome

Primary Author Last Name	Year Published	Level of Abstinence Measured	Total Sample Size	Treatment Group	Control Group
Milby	2005	Consecutive Weeks Abstinent	132	Abstinent Contingent Housing	No Housing
Collard	2014	Duration of Weeks Sober	68	Housing Non-Abstinent	No Housing
Tsemberis	2004	Total Days Abstinent	225	Housing First	Treatment First

Figure 5 depicts the effect sizes for each study as well as the overall effect size[24] derived from the fixed and random effect model. Two studies show a significant positive treatment impact of non-abstinent contingent housing on duration of abstinence, while one fails to show a significant relationship.

[24] Only one study was weighted at 0.9 or 90% due to quasi-experimental study design, without adequate controls (Collard, 2014). A second study (Tsemberis, 2004) was weighted at 0.8 due to the reliance on only self-report data and the lack of involvement from an outsider (e.g. all authors were connected to the program being studied).

Figure 5: Cohen's D Effect Sizes for the 'Duration of Abstinence' Outcome



The overall effect size shows a significant relationship between non-abstinent contingent housing and duration of abstinence, translating into non-abstinent contingent housing having a small to moderate positive effect size (D=0.37**) for increasing the duration of abstinence when compared to control groups.

What is more, these results, when coupled with the first results for abstinence, suggest that non-abstinent contingent housing is significantly better than treatment as usual at increasing the duration of abstinence, yet not significantly better at achieving total abstinence. These results are not completely unexpected given that these homes will not evict residents if they use again and given the high comorbidity present. Thus, while providing its residents with what many believe are the core tools for abstinence (e.g. a safe place to live), non-abstinent contingent housing does not fully disincentivize its residents from using drugs and alcohol when they are living in these homes. For that reason, we could fully expect to see an increased duration of abstinence outcome. However, the program's disincentives do not necessarily prompt residents to fully abstain from using.

Healthcare Utilization (Number of Emergency Department Visits)

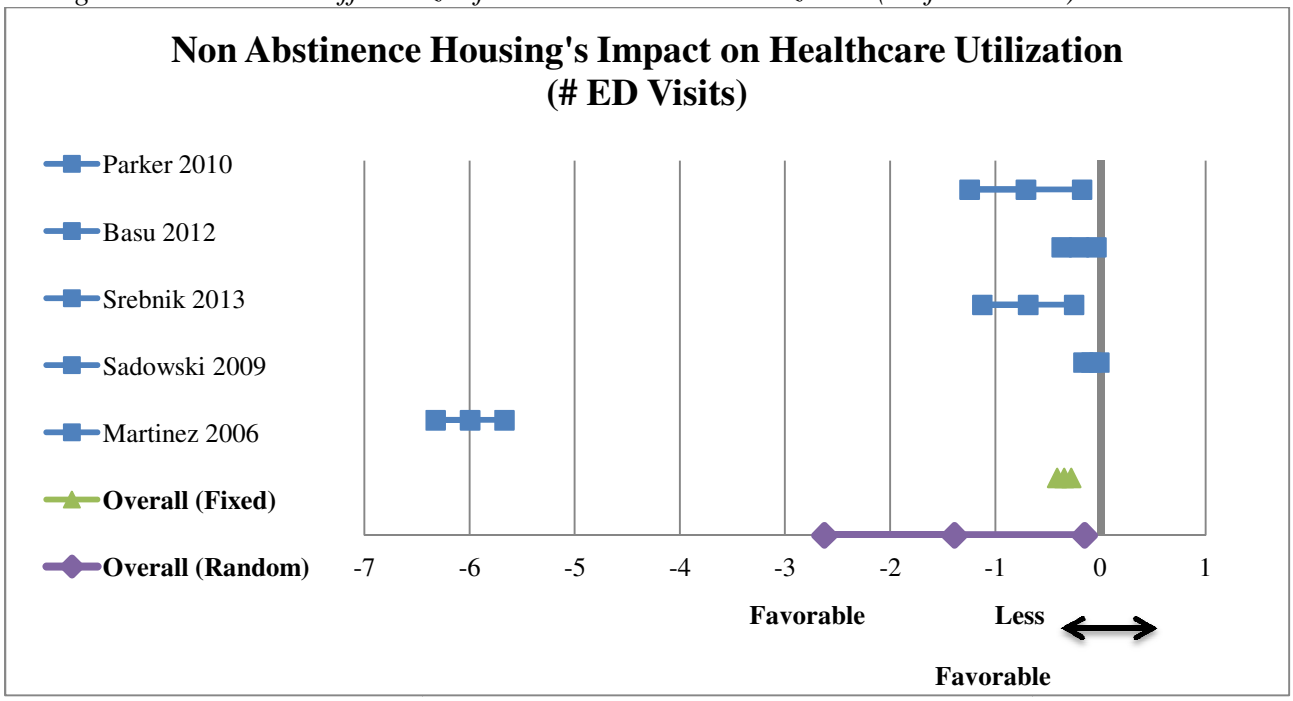
Five studies report whether non-abstinent contingent housing has an impact on the number of emergency department visits. The sample sizes of all four studies range from 40 to 1,941 participants. Study characteristics for these studies are in Table 10.

Table 10: Study Characteristics with 'Healthcare Utilization (# of ED Visits)' Outcome

Primary Author Last Name	Year Published	Total Sample Size	Treatment Group	Control Group
Basu	2012	405	Housing (+ Case Mgmt)	Usual Care
Srebnik	2013	60	After Housing First	Before Housing First
Sadowski	2009	1,941	Housing First	Usual Care
Martinez	2006	236	After Non-Abstinent Contingent Housing	Before Non-Abstinent Contingent Housing
Parker	2010	40	After Housing First	Before Housing First

Effect sizes for each study are computed, as well as an overall effect size[25] with fixed and random effects. The effect sizes are depicted in Figure 6. All five studies have a negative statistically significant relationship between non-abstinent contingent housing and the number of emergency department visits.

Figure 6: Cohen's D Effect Sizes for the 'Healthcare Utilization (# of ED Visits)' Outcome



[25] Martinez (2006) & Parker (2010) were weighted at .9 due to their quasi-experimental study design without adequate controls, while Srebnik (2013) had no outside authorship.

Figure 6 shows an overall negative significant relationship between non-abstinent contingent housing and the number of emergency department. Non-abstinent contingent housing is shown to have a large impact in this area (D=-1.388**), which translates into significantly decreasing the number of emergency department visits, when compared to control groups.

These findings are supported by other studies as well; i.e., studies conducted by Larimer (2009) and a 2010 Portland Area study of the Bud Clark Apartments. These studies—which are not used in this particular meta-analysis due to a lack of information necessary to calculate an effect size—provide healthcare data for non-abstinent contingent housing members and those in usual care.

Larimer's 2009 study examines healthcare and public service use and costs before and after Housing First treatment was received. Larimer (2009) finds that Housing First participants have a median monthly cost (total cost for public health provisions) that tops $4,000 per person one year prior to the treatment intervention (e.g. Housing First). Subsequently, Larimer (2009) reports that these monthly rates fell to $1,492 in the six months following treatment intervention, and to $958 12 months following the intervention. What is more, Larimer (2009) concludes that Housing First is associated with a 53% decrease[26] in the total cost rate for public service provision, relative to those on the waitlist for Housing First.

Likewise, a Portland area health-focused evaluation of the Bud Clark Apartments (conducted by the Center for Outcome Research and Evaluation) finds that in the year prior to entrance into Bud Clark Apartments, residents on Medicaid averaged a total healthcare cost that topped $1,600 a month. However, in the years following admittance into the Bud Clark Apartments, these costs fell to $899 at the end of year one, $995at the end of year two, and $680 beyond 2 years[27]. Thus, while not included in this meta-analysis, both of these studies show complementary evidence for the impact of non-abstinent contingent housing on health care utilization.

Criminal Justice (Number of Days in Jail)

Three studies report the number of days in jail after entering non-abstinent contingent housing. The sample sizes of all four studies range from 129 to 245 participants; further study characteristics are contained in Table 11. The time of follow up after the initial treatment ranges from 6 month to 24 months.

Table 11: Study Characteristics with 'Criminal Justice (# of Days in Jail) Outcome

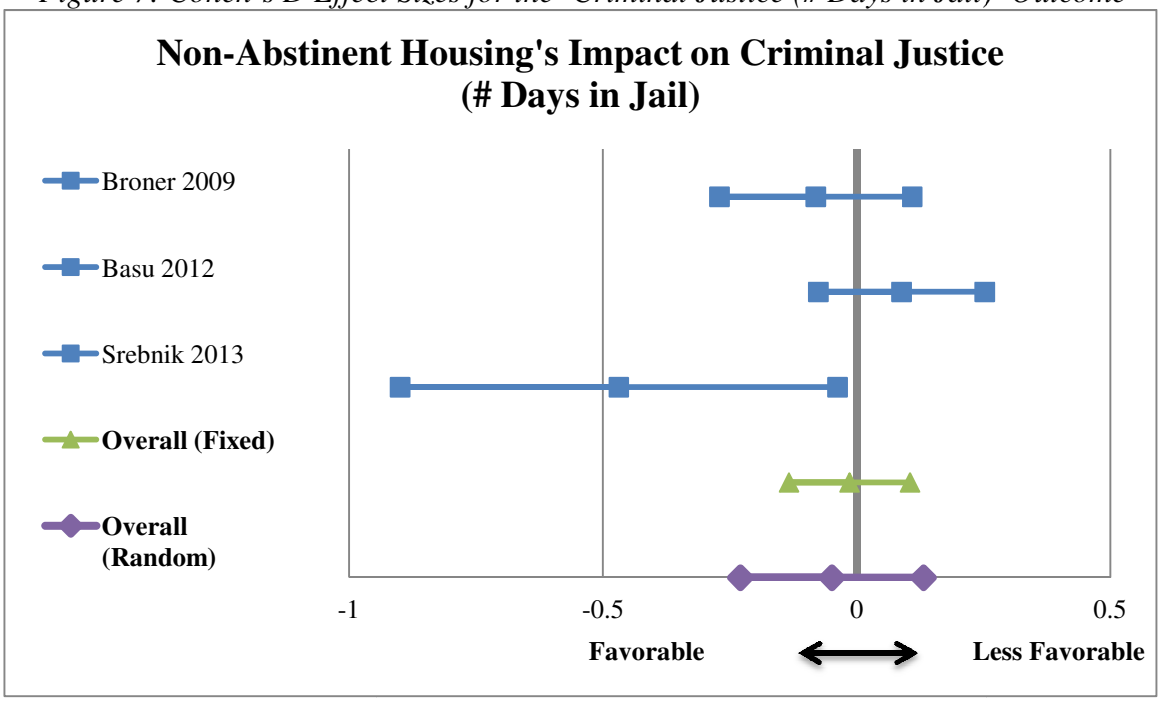
Primary Author Last Name	Year Published	Total Sample Size	Treatment Group	Control Group
Basu	2012	405	Housing (+Case Mgmt)	Usual Care
Srebnik	2013	60	After Housing First	Before Housing First
Broner	2009	589	Non-Abstinent Contingent Housing	No Housing

[26] This data was found to be statistically significant

[27] This data was found to be statistically significant

Effect sizes for each study are computed, as well as an overall effect size[28] with fixed and random effects. The effect sizes are depicted in Figure 7. One study has a significant negative relationship between non-abstinent contingent housing and the number of days in jail. Two studies are not statistically significant.

Figure 7: Cohen's D Effect Sizes for the 'Criminal Justice (# Days in Jail)' Outcome



The overall effect size is not significant. Hence, there does not appear to be a significant impact of non-abstinent contingent housing on the number of days in jail, although outcomes do vary between individual studies.

Employment

Our analysis uncovered two non-abstinent contingent studies that examine employment rates (Kertesz, 2007; Parker, 2010). However, there is not enough adequate literature to conduct a proper meta-analysis. Regardless, these studies can still be used to help inform the impact of this treatment intervention on employment outcomes.

Overall, neither study reports statistically significant findings for employment. Kertesz (2007) conducts an experiment that examines the differences between employment rates for those in non-abstinent contingent housing and those with no housing. Results at follow up show a slight, albeit non-significant, difference in employment outcomes between those in non-abstinent contingent housing and those not housed--with those in the non-abstinent contingent housing group having slightly higher rates of employment than the control group (33.3% vs. 25.6%). Likewise, Parker (2010) uses a pre-post analysis to test the differences in employment rates six months before, and six months following, a non-abstinent contingent housing

[28] Srebnik (2013) and Broner (2009) were weighted at 0.9 or 90% due to lack of outside authorship and a quasi-experimental study design without adequate controls, respectively.

intervention. Similar to Kertesz, Parker (2010) finds slight, albeit non-significant, increases in employment (0% vs. 1%) following non-abstinent contingent housing intervention.

Conclusion

Overall, a meta-analysis examining the impact of non-abstinent contingent housing is mixed. Non-abstinent contingent housing has better duration of abstinence (small to moderate) and healthcare utilization outcomes (large) than control groups. However, non-abstinent contingent housing does not seem to have better abstinence and criminal justice outcomes than control groups. Employment, healthcare utilization outcomes, and treatment engagement do not contain appropriate studies for analysis. For that reason, they are excluded from this analysis. However, non-meta-analyzable research to date finds that non-abstinent contingent housing employment has no impact on employment. What is more, when compared to other wraparound and medication assisted treatments, non-abstinent contingent housing appears to have the "biggest" magnitude for reducing healthcare utilization.

Meta-analytic results can be powerful in generating research conclusions. However, all results should be interpreted carefully and with caveats. For instance, moving beyond the caveats with meta-analysis, the lack of a significant impact of non-abstinent contingent housing on abstinence does not necessarily mean that this treatment is ineffective for reducing substance use. Recall that the program purposefully does not create a huge disincentive to be fully abstinent—instead, it is focused on giving individuals tools to address their addiction in time, which appears to drive the duration of abstinence (time abstinent) better than abstinence (dichotomous measure). Some studies, not analyzed here, note reductions in quantity and frequency of use, particularly in alcohol abuse. In other words, given the nature and goals of non-abstinent contingent housing, a dichotomous variable of abstinence may be a nonsensical indicator of this outcome. What is more, study findings for employment, which were non-significant, were limited given that only two studies were collected. For that reason, robust conclusions on employment cannot be made here.

Wraparounds: Abstinent Housing

Abstinent contingent housing is a wraparound service that offer residents housing on the basis that inhabitants obey house rules—*including staying clean and sober* (Jason, 2006 & 2015; La Sasso 2012; Polcin 2010a, Milby, 2005). These types of homes utilize a community-based model, whereby residents live, typically for as long as they desire, without the assistance of professional staff. This service often allows residents to seek whichever type of (if any) substance abuse treatment they desire (Jason, 2006). Furthermore, Polcin (2010a) explains that popular abstinent contingent housing programs, such as the Oxford House or Sober Living House model, utilize similar core models of management (e.g. routine drug tests, long-term residential opportunities, no professional staff, emphasis on peers, etc.) and only vary on a handful of factors (e.g. whether they are democratic, etc.).

The surveyed literature on abstinent contingent housing highlights the benefits of abstinent contingent housing. Overall, the literature shows a variety of improvements in treatment recipients (Polcin 2010a), like better drug and alcohol use outcomes (Jason, 2006, 2007b, 2015; Jason, 2007), higher employment income, decreased illegal activity (La Sasso, 2012), and increased self-efficacy (Jason, 2007, Davis, 2005). Ultimately, the treatment option is classified as a stabilizing, efficacious, efficient, and practical treatment option, that when closely

analyzed, yields high benefits for treatment recipients and the public at large (Milby, 2000, 2003, 2005; Jason, 2015; La Sasso, 2012).

Methods

Articles for the abstinent contingent housing analysis were located via searches in the Oregon State University article databases and Google Scholar. The keywords used for searches paired substance/drug/alcohol abuse with: "Oxford House", "abstinent contingent housing", "housing abstinent", and "housing substance abuse". After reviewing these databases, 16 studies were initially chosen for analysis. Studies were initially chosen if they were quantitative, had a control and treatment group, and if they were published after the year 2000. After a closer review, which examined studies to see if they had published the necessary data to calculate an effect size,14 of the 16 collected studies were found appropriate for meta-analysis.

Results

Of the 14 studies that fit the criteria for analysis, four treatment outcomes (abstinence, duration of abstinence, crime, and employment) are identified in the studies. Healthcare utilization outcomes and treatment engagement do not contain appropriate studies for analysis. The overall effect sizes in Table 12 are presented in Cohen's D, log odds, and odds ratio form.

Table 12: Summary of Effect Size Results

Parameter	Number of Studies	D	Log Odds	Odds Ratio
All Studies	12		--	--
Substance Use Outcomes				
Abstinence	9	.54**	.98**	2.67**
Duration of Abstinence	3	$.72^{**}_{F}$	1.31^{**}_{F}	3.69^{**}_{F}
Criminal Justice Outcomes				
Arrested	4	-.45**	-.82**	.44**
Employment				
Employed	5	.59**	1.07**	2.92**

*** Indicates 95% Confidence; * Indicates 90% Confidence; $_F$ indicates a fixed effects model*

Abstinence

Nine studies measure the impact of abstinent contingent housing on abstinence. Important characteristics of these studies are detailed in Table 13. Figure 1 displays the effect size of each study in the log odds format with the confidence interval surrounding it.

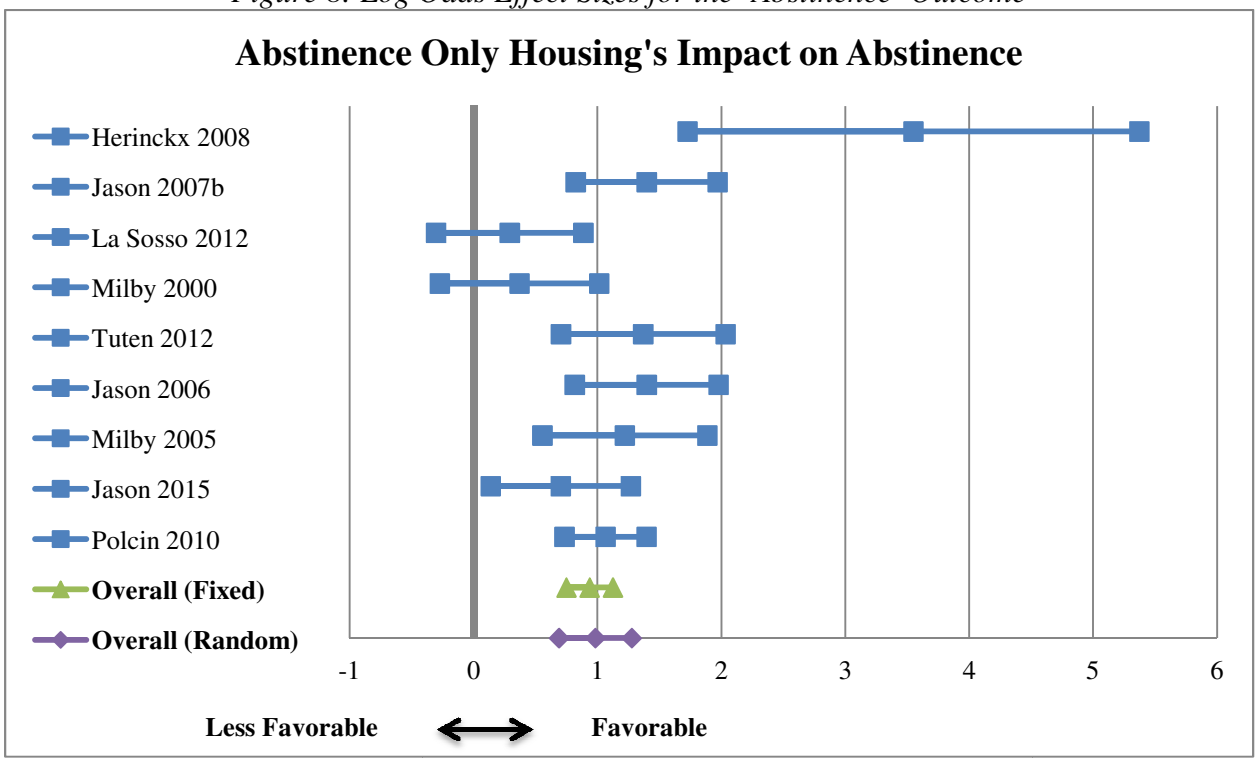
Table 13: Study Characteristics with 'Abstinence' Outcome

Primary Author Last Name	Year Published	Follow-up Duration after Beginning Treatment	Total Sample Size (N)	Type of Abstinence Use Measured	Treatment Group	Control Group
Jason	2006	24 Months	146	Total	Oxford	Usual Care
Milby	2005	6 Months	133	Drug	Abstinent Contingent Housing	No Housing
Jason	2015	24 Months	144	Alcohol	Oxford	Usual Care
Polcin	2010	6 months	245	Alcohol	Post Oxford	Pre Oxford
Tuten	2012	6 Months	163	Drug	Recovery House	Usual Care
Milby	2003	12 Months	141	Drug	Day Treatment + Housing	Day Treatment Only
La Sasso	2012	12 Months	127	Total	Oxford	Usual Care
Jason	2007b	24 Months	150	Total	Oxford	Usual Care
Herinckx	2008	Post Treatment	174	Drug (Meth)	After ADFC Housing	Before ADFC Housing

The overall effect size[29] is displayed with a fixed effects model and random effects model. Two of the studies were not statistically significant. Seven studies have a statistically significant positive relationship between abstinent contingent housing and the odds of abstinence (e.g. favorable towards the abstinent contingent housing intervention) and no studies have a negative relationship.

[29] All studies were unadjusted (e.g. weighted by a factor is 1) with the exception of La Sasso et al. (2012), Polcin et al. (2010), and Herinckx (2008), which were weighted at 0.9, .0.8, and 0.8, respectively. These studies' effect sizes were adjusted due to the quasi-experimental design (without adequate controls) and reliance on only self-report data.

Figure 8: Log Odds Effect Sizes for the 'Abstinence' Outcome



The combined effect size shows a relationship between abstinent contingent housing and likelihood of being abstinent that is significantly positive. Further interpretation of the log odds can be expressed with an equivalent odds ratio and Cohen's D. The overall effect size, OR= 2.67**, means that across all the selected studies, the odds of abstinence for those in abstinent contingent housing are 2.67 times that (167%) of control groups. This translates into abstinent contingent housing having a moderate to large effect size (D=.54**) for increasing abstinence, when compared to control groups. The literature suggests that abstinent contingent housing is better at achieving abstinence than usual care without housing, with minimal variation between individual studies.

Duration of Abstinence

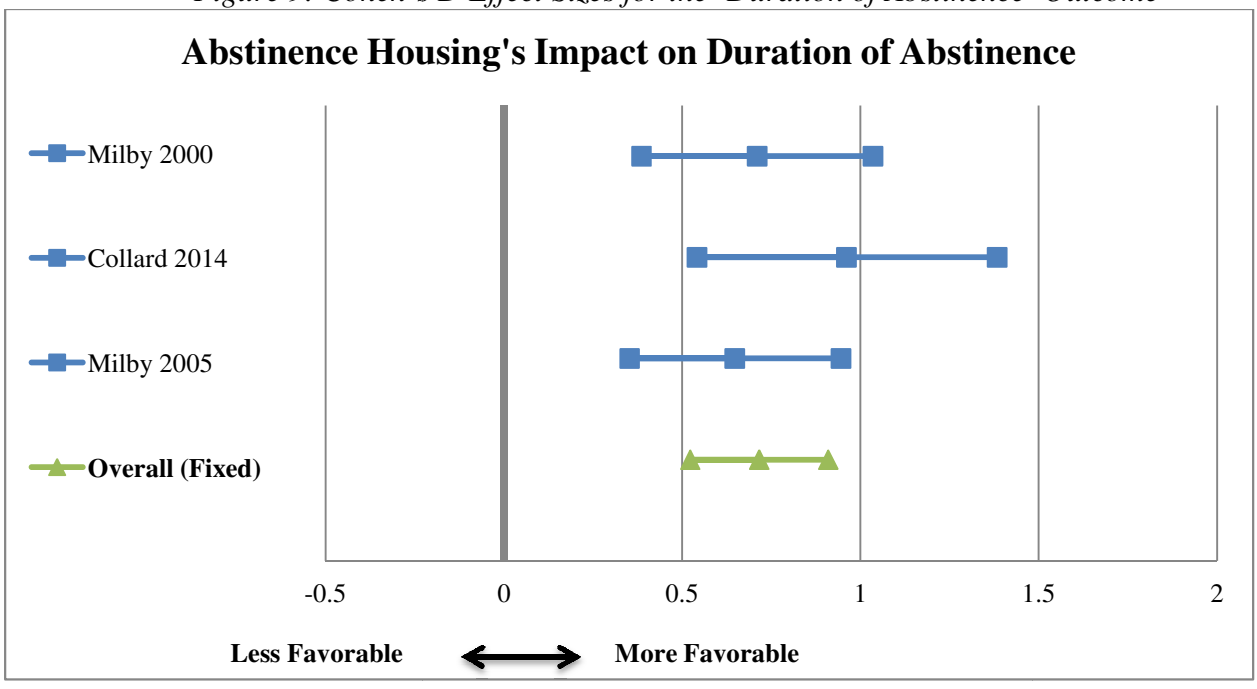
Three studies include outcome variables that measured the impact of abstinent contingent housing on the duration of abstinence individuals achieved. The total sample size of these studies ranges from 68 to 132, and duration of abstinence was reported in several different ways. However, it was determined that the outcomes were similar enough for a meta-analysis to be conducted, given that each measured duration of abstinence based on the number of days or weeks a individual could maintain abstinent. This, and further information, is recorded in Table 14.

Table 14: Study Characteristics with 'Duration of Abstinence Outcome

Primary Author Last Name	Year Published	Level of Abstinence Measured	Total Sample Size	Treatment Group	Control Group
Milby	2005	Consecutive Weeks Abstinent	132	Abstinent Contingent Housing	No Housing
Collard	2014	Number of Weeks Sober	68	Housing Abstinent	No Housing
Milby	2000	Percent of Days Sober	110	Day Treatment+ Housing	Day Treatment Only

Figure 9 depicts the effect sizes for each study as well as the overall effect size[30] with only fixed effects. A random effects model is neither necessary in this instance (the Q test for homogeneity was not rejected) nor possible, given that the random effects model had a negative variance. Ultimately, the random effects model simplifies to equal the fixed effects model in this instance. All three studies report a statistically significant positive relationship between abstinent contingent housing and duration of abstinence.

Figure 9: Cohen's D Effect Sizes for the 'Duration of Abstinence' Outcome



The overall effect size shows a significant positive relationship between abstinent contingent housing and duration of abstinence that is moderate to large in nature (D=0.72**$_F$),

[30] Only one study (Collard, 2014) was weighted at 0.9 or 90% due to study design. Collard (2014) utilized a quasi-experimental design without adequate controls.

suggesting that the addition of housing to treatment has an important impact on treatment outcomes. .

Criminal Justice Outcome (Arrested)

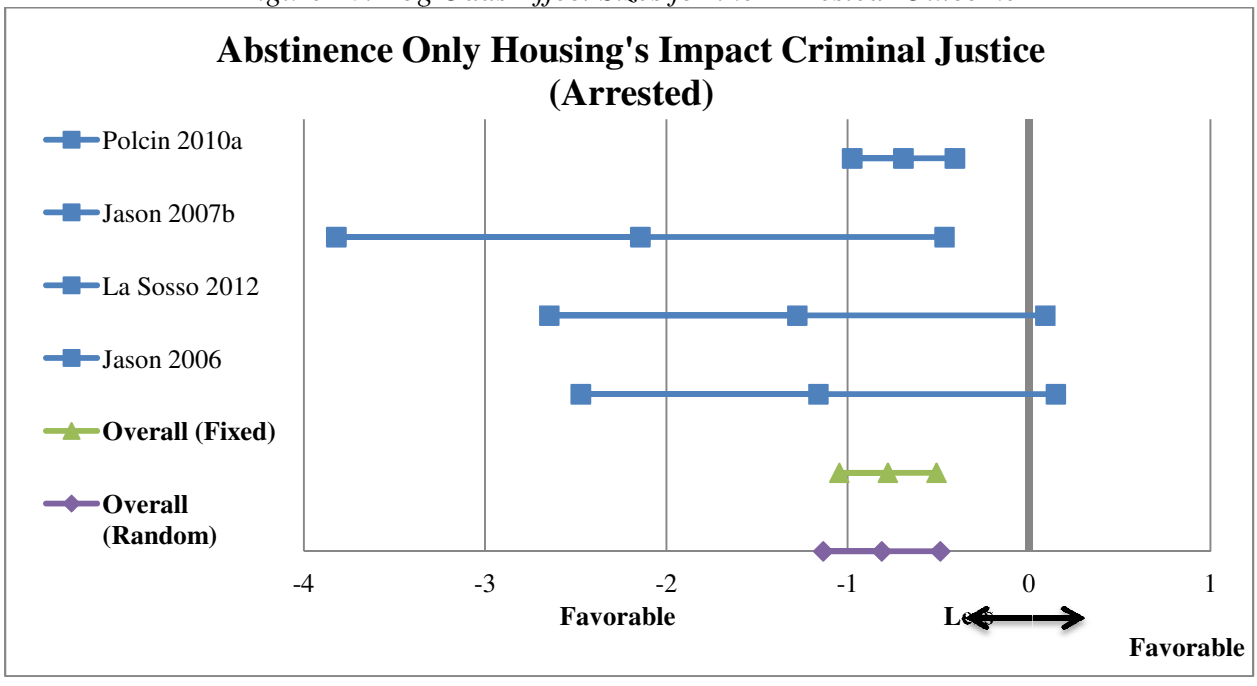
Four studies report whether a study participant has been arrested after entering abstinent contingent housing. Across all selection studies, the sample sizes range from 129 to 245 participants. Table 15 displays the essential characteristics of these studies. [31] The time of follow up after the initial treatment ranges from 6 months to 24 months.

Table 15: Study Characteristics with 'Incarceration' Outcome

Primary Author Last Name	Year Published	Follow-up Duration after Beginning Treatment	Total Sample Size	Treatment Group	Control Group
Jason	2006	24 Months	146	Oxford House	Usual Care
La Sosso	2012	12 Months	129	Oxford House	Usual Care
Jason	2007b	24 Months	150	Oxford House	Usual Care
Polcin	2010	6 months	245	After Oxford	Before Oxford

The effect sizes are depicted in Figure 10 in the log odds format. Two studies have a statistically significant negative relationship between abstinent contingent housing and the likelihood of incarceration. Two studies are not significant.

Figure 10: Log Odds Effect Sizes for the 'Arrested' Outcome



[31] La Sosso (2012) and Jason (2007b) were weighted at 0.9 or 90% due to their reliance on only self report data.

Using log odds, it is clear in Figure 10 that the overall effect size still shows a negative significant relationship between abstinent contingent housing and likelihood of arrest. The overall odds ratio, OR= 0.44**, means that across all the selected studies, the odds of incarceration for those in abstinent contingent housing is 0.44 times (-56%) that of control groups. This translates into abstinent contingent housing having a small to moderate effect size (D=-0.45**) for decreasing the odds of arrest, when compared to control groups.

The above analysis shows that there is a statistically significant negative impact of abstinent contingent housing on criminal justice outcomes, as measured by arrest. These results are supported by an Alcohol and Drug Free Community (AFDC) study conducted by Portland State University (Herinckx, 2008). This study, which is not used in this section of the meta-analysis because it lacked the necessary information to calculate an effect size, shows high rates of crime and income earned from illegal activity prior to the introduction of an AFDC. However, in the year following introduction to the AFDC, the Portland State University study reports a 93 percentage point decrease in the number of individuals reporting criminal behavior. Likewise, the same study shows that monthly income earned from illegal activity drop dramatically--from $1,978 a month (one year prior to the AFDC introduction) to $6 a month (one year following the ADFC introduction).

Employment

Five studies report whether a study participant is employed after entering abstinent contingent housing. The sample sizes of all five studies range from 68 to 163 participants. Study characteristics for these studies are in Table 16.

Table 16: Study Characteristics with 'Employed' Outcome

Primary Author Last Name	Year Published	Total Sample Size	Treatment Group	Control Group
Jason	2007b	150	Oxford	Usual Care
Kersetz	2007	84	Housing Abstinent	No Housing
Tuten	2012	163	Recovery Housing	Usual Care
La Sosso	2012	129	Oxford	Usual Care
Collard	2014	68	Housing Abstinent	Usual Care

Effect sizes for each study are computed, as well as an overall effect size[32] with fixed and random effects. The effect sizes are depicted in Figure 11 in the log odds format. Five studies have a statistically significant and positive relationship between abstinent contingent housing and being employed. One study is not statistically significant.

[32] All studies were weighted at 0.90 or 90%, due to the reliance on only self-report data and, in one case, a quasi-experimental design without adequate controls (Collard, 2014).

Figure 11: Log Odds Effect Sizes for the 'Employment' Outcome

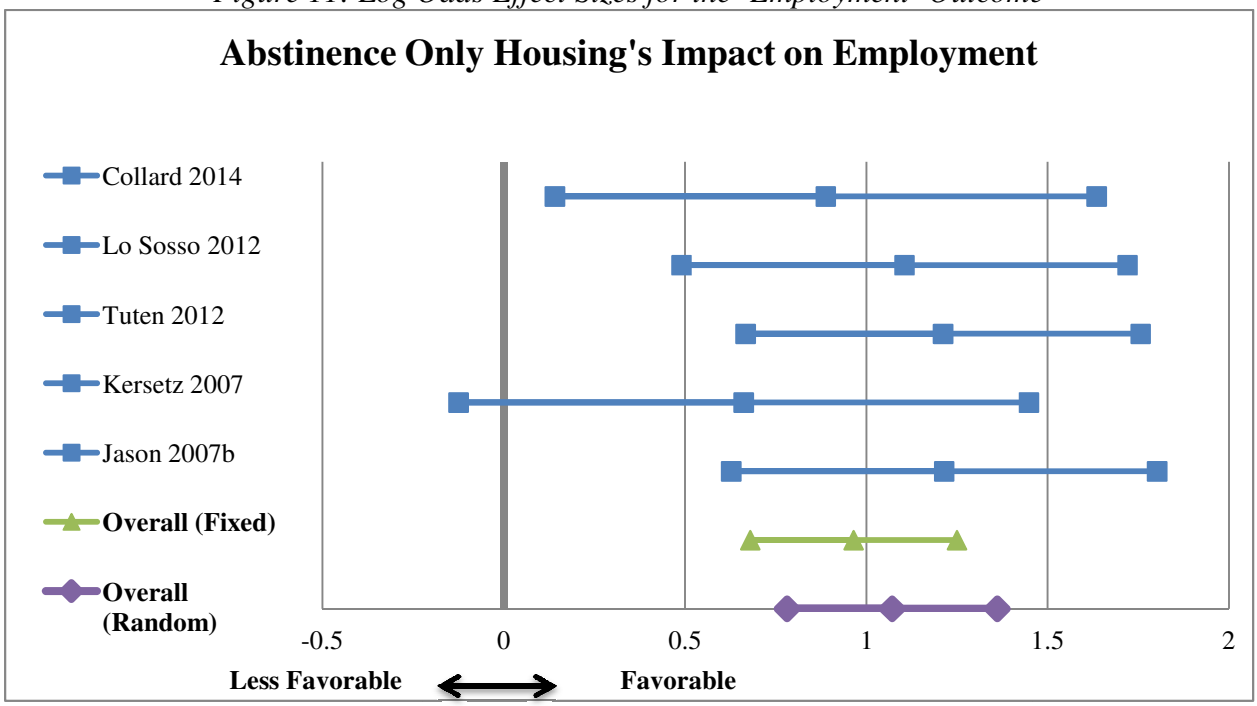


Figure 11 shows that the overall effect size is significantly positive, suggesting that abstinent contingent housing increases the odds of employment. Further interpretation of these log odds can be expressed with an equivalent odds ratio and Cohen's D. The overall effect size, OR= 2.92**, means that across all the selected studies, the odds of employment for those in abstinent contingent housing is 2.92 times (192%) that of control groups. This translates into abstinent contingent housing having a moderate to large effect (D=0.59**) for increasing odds of employment, when compared to control groups.

The above meta-analysis shows that there is a statistically significant positive impact of abstinent contingent housing on employment. These findings are also supported by studies conducted by Jason (2006), Belayev-Glantsman (2009), and Tuten (2012). These studies, which are not used in this particular meta-analysis due to a lack of information necessary to calculate an effect size, provide employment earnings for both abstinent contingent housing members and those in usual care. All three show that those in abstinent contingent housing have (statistically) significantly higher monthly earnings on average, compared to control groups: $989 vs. $448 (Jason, 2006); $1,032 vs. $635 (Belayev-Glantsman (2009); $510 vs. $244 (Tuten, 2012).

Treatment Engagement

There is insufficient literature to do a meta-analysis on this outcome. However, a study that was used for other outcomes in this meta-analysis (Schumacher, 2000) does collect some information on this topic area. For instance, Schumacher (2000) shows that those in this treatment group attended 92.5% of days of treatment, compared to 60% of those in the control group[33]. Likewise, the median number of treatment days attended for the treatment group is 168.5, compared to just 100 for the control group. Hence, while not enough information for a full

[33] This was shown to be statistically significant

meta-analysis, this study does start to give some evidence of another potential positive impact of abstinent contingent housing.

Conclusion

Overall, the meta-analysis examining the impact of abstinent contingent housing is promising. Abstinent contingent housing has better abstinence (moderate to large), duration of abstinence (moderate to large), criminal justice (small to moderate), and employment outcomes (moderate to large) than control groups. However, not all outcomes, like healthcare utilization, can be analyzed for this wraparound service. Ultimately, abstinent contingent housing outperforms all other wraparound and medication assisted treatments, in terms of relative magnitude, when analyzing abstinence, duration of abstinence, and employment. In other words, abstinent contingent housing had the largest magnitude of effect for these three outcome areas.

Like meta-analytic results for non-abstinent contingent housing, all meta-analytic results should be interpreted carefully. For instance, unlike non-abstinent contingent housing, abstinent contingent housing is centered on requiring abstinence. Hence, individuals that test positive for drug or alcohol use are removed from housing. This obviously creates a strong disincentive for drug and alcohol use—a disincentive that isn't present in the previous meta-analysis for non-abstinent contingent housing. Thus, significant impacts of abstinent contingent housing on abstinence does not necessarily mean that this treatment is more effective for long-term abstinence than non-abstinent contingent housing, if this effect is strong enough. Instead, it may just mean that the specific indicator for abstinence (a dichotomous measure) is more appropriate for this treatment option than it is for others (e.g. non-abstinent contingent housing).

Wraparounds: Case Management

Case management attempts to foster recovery via professional services coordination. Given that substance abuse issues rarely take place within a vacuum, those in treatment/recovery are often faced with an onslaught of challenges that extend beyond "simple" substance abuse treatment. These challenges can be rather general, such as challenges scheduling required treatments, or rather complex, such as challenges ranging from dealing with the criminal justice system to issues with mental health or chronic homelessness. Accordingly, these interventions focus on providing those battling substance abuse with professional liaisons that can help coordinate any range of issues that are related to recovery (Godley, 2000; Prendergast, 2011), including outreach, planning, treatment coordination, follow-up, and crisis management (Morgenstern, 2006;).

The surveyed literature for case management highlights a treatment option with mixed results. For instance, Godley (2000) and Heinmann (2004) suggest that case management can yield life improvements in most areas that were studied. Likewise, Morgernstern (2006) and Pope (2000) both classify case management as a relatively promising intervention for substance abuse issues—yet, both stop short of explicitly endorsing the treatment program. However, others like Needles (2006) fail to find a long-term impact of case management, while Guydish (2011) and Sorensen (2003) fail to find any impacts of case management on multiple outcomes of interest. Our analysis found significant impact in two areas—healthcare utilization and treatment engagement—but none in abstinence or criminal outcomes. Given the nature of case management, however, this may be perfectly logical. Case managers aid with navigating systems and appointments—thus, treatment engagement is an apt fit. Healthcare utilization, as operationalized by emergency department visits, is also logical—prevailing wisdom suggests

that better primary healthcare and preventive services, such as a case manager can arrange, can prevent ER visits in the future.

Methods

Articles for case management were located via searches in the Oregon State University article databases and Google Scholar. The keywords used for searches paired substance/drug/alcohol abuse with: "case management" and "case manager. " After reviewing these databases, 20 studies were initially chosen for analysis, per study criteria. After a closer review, 16 of the 20 collected studies were found appropriate for meta-analysis.

Results

Of the 16 studies, five treatment outcomes (abstinence, duration of abstinence, healthcare utilization, criminal outcomes, and treatment engagement) are identified. Studies with employment outcomes do not contain appropriate information to be included in the analysis. The overall effect sizes in Table 17 is presented in Cohen's D, log odds, and odds ratio form.

Table 17: Summary of Effect Size Results

Parameter	Number of Studies	D	Log Odds	Odds Ratio
All Studies	16		--	--
Substance Use Outcomes				
Abstinence	7	.16	.29	1.34
Duration of Abstinence (Alc)	3	.03	.05	1.06
Duration of Abstinence (Drug)	3	.15	.27	1.31
Healthcare Utilization				
# of ED Visits	4	-.53**	-.96**	.38**
Crime Outcomes				
Arrested	4	-.2	-.37	.69
Treatment Engagement				
Attended	5	.25**	.45**	1.57**

*** Indicates 95% Confidence; * Indicates 90% Confidence; $_F$ indicates a fixed effects model*

Abstinent

Seven studies measure the impact of case management on abstinence. Additional information for these studies is detailed in Table 18. Figure 1 displays the effect size of each study in log odds format with the confidence interval surrounding it.

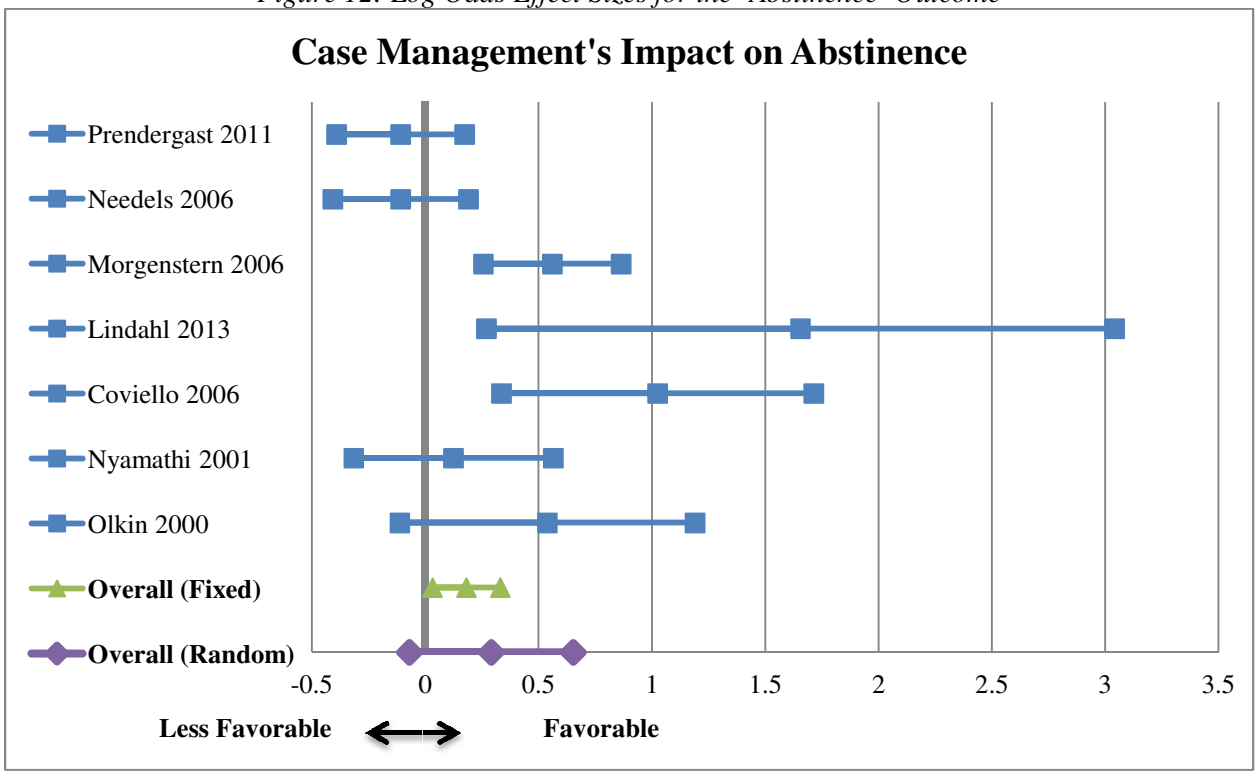
Table 18: Study Characteristics with 'Abstinence' Outcome

Primary Author Last Name	Year Published	Follow-up Duration after Beginning Treatment	Total Sample Size (N)	Type of Abstinence Use Measured	Treatment Group	Control Group
Olkin	2000	12 Months	106	Drug	Post Case Management	Pre Case Management
Nyamathi	2001	6 Months	225	Total	Case Management	Standard Care
Coviello	2006	6 Months	122	Drug	Case Management	Passive Referral
Lindahl	2013	6 Months	34	Total	Case Management	Treatment as Usual
Morgenstern	2006	15 Months	291	Total	Intensive Case Management	Usual Care
Needles	2067	Follow Up	511	Total	Jail + Community Services (females)	Jail Services Only (females)
Prendergast	2011	9 Months	691	Total	Traditional Case Management	Standard Referral

The overall effect size[34] is displayed with a fixed effect model and random effects model. Four of the studies are not statistically significant. The other three studies have a statistically significant positive relationship between case management and abstinence.

[34] Two studies were adjusted to 0.9 (Olkin, 2000; Lindahl, 2013) because of the quasi-experimental study design (without adequate controls) in the former and the reliance on only self-report data in the latter.

Figure 12: Log Odds Effect Sizes for the 'Abstinence' Outcome



The meta-analyzed relationship between case management and abstinence is just barely insignificant. Outcomes vary greatly between individual studies, which can suggest that further research may be necessary to fully elucidate its true effect.

Duration of Abstinence

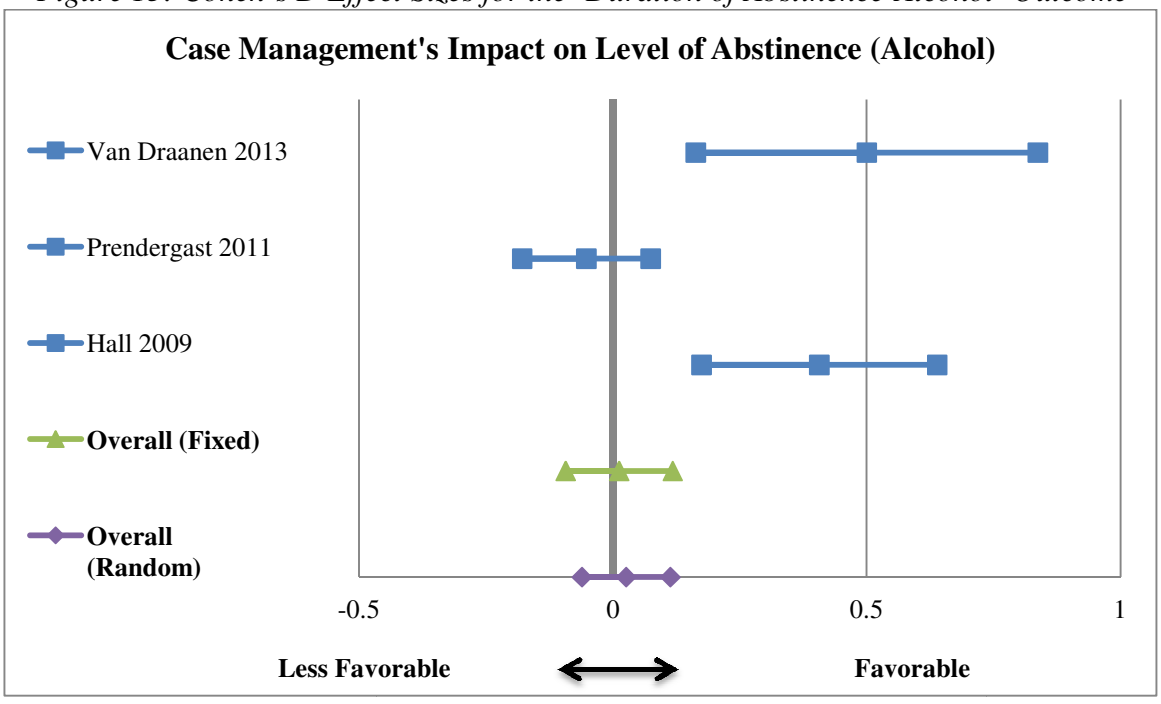
Three studies include outcome variables that measure the impact of case management on duration of abstinence. The duration of abstinence outcome captures the number of days abstinent following treatment. The total sample size of these studies ranges from 81 to 849 and duration of abstinence is tested for both alcohol and drugs. This, and further information, is recorded in Table 19.

Table 19: Study Characteristics with 'Duration of Abstinence Outcome

Primary Author Last Name	Year Published	Level of Abstinence Measured	Total Sample Size	Treatment Group	Control Group
Hall	2009	Days Abstinent (A&D)	202	Intensive Case Management	Treatment as Usual
Prendergast	2011	Days Abstinent (A&D)	681	Traditional Case Management	Standard Referral
Van Draanen	2013	Days Abstinent (A&D)	103	Post Case Management	Pre Case Management

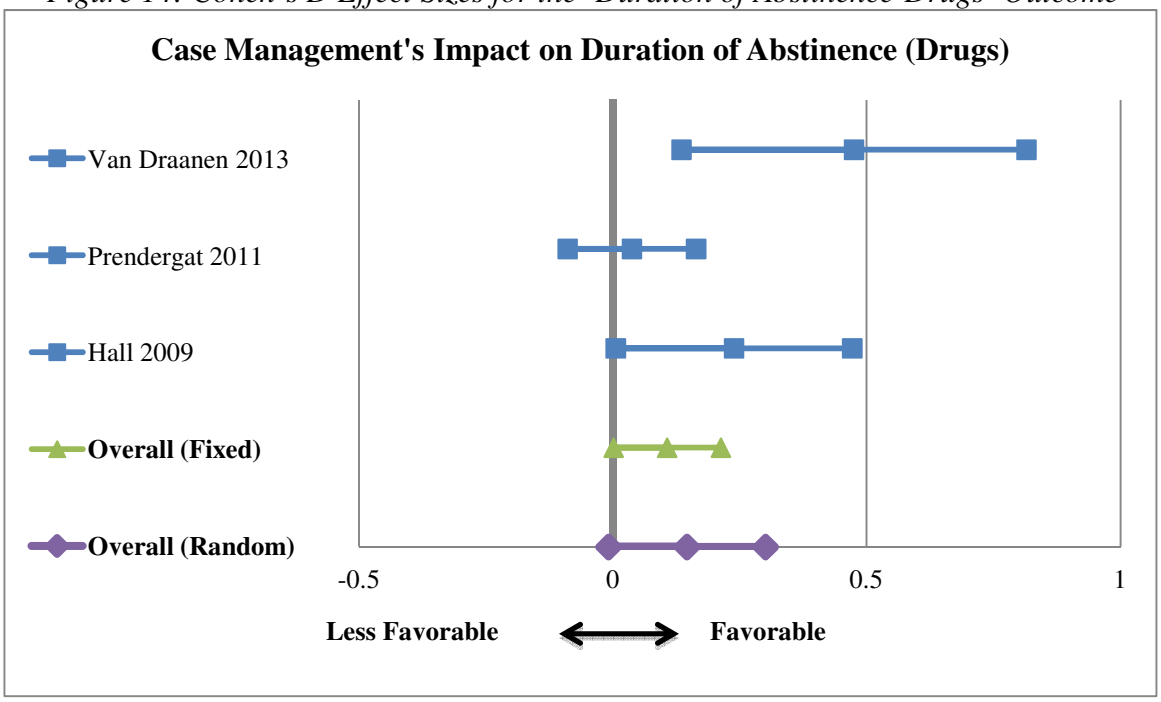
Figures 13 and 14 depict the effect sizes for each study as well as the overall effect size[35] derived from the fixed and random effect model. Two studies show a significant positive impact on the duration of abstinence from both alcohol and drugs, while one fails to show any significant relationship.

Figure 13: Cohen's D Effect Sizes for the 'Duration of Abstinence-Alcohol' Outcome



[35] Only one study (Hall, 2009) was weighted at 0.9 or 90% due reliance on only self report data while Van Draanen (2013) was weighted at 0.8 due to the reliance on self report data and the use of a quasi-experimental study design without adequate controls.

Figure 14: Cohen's D Effect Sizes for the 'Duration of Abstinence-Drugs' Outcome



There does not appear to be any significant effect of case management on the duration of abstinence from alcohol or drugs, despite individual variations within the studies—although duration of time abstinent from drugs came close[36].

Likewise, non meta-analyzed results from Bennett (2006) show a similar trend. For instance, results at 3 and 6 months show slightly less heroin use for those in case management, relative to usual care (14.13 days of use in case management and 11.75 days of use in usual care; followed by 11.47 days of use in case management and 10.26 days of use in usual care). However, none of these differences were found to be statistically significant, indicating these results may have occurred by chance or via study errors.

Healthcare Utilization (Number of Emergency Department Visits)

Four studies report whether case management had an impact on the number of emergency department visits. The sample sizes of all four studies range from 18 to 252 participants. Study characteristics for these studies are in Table 20.

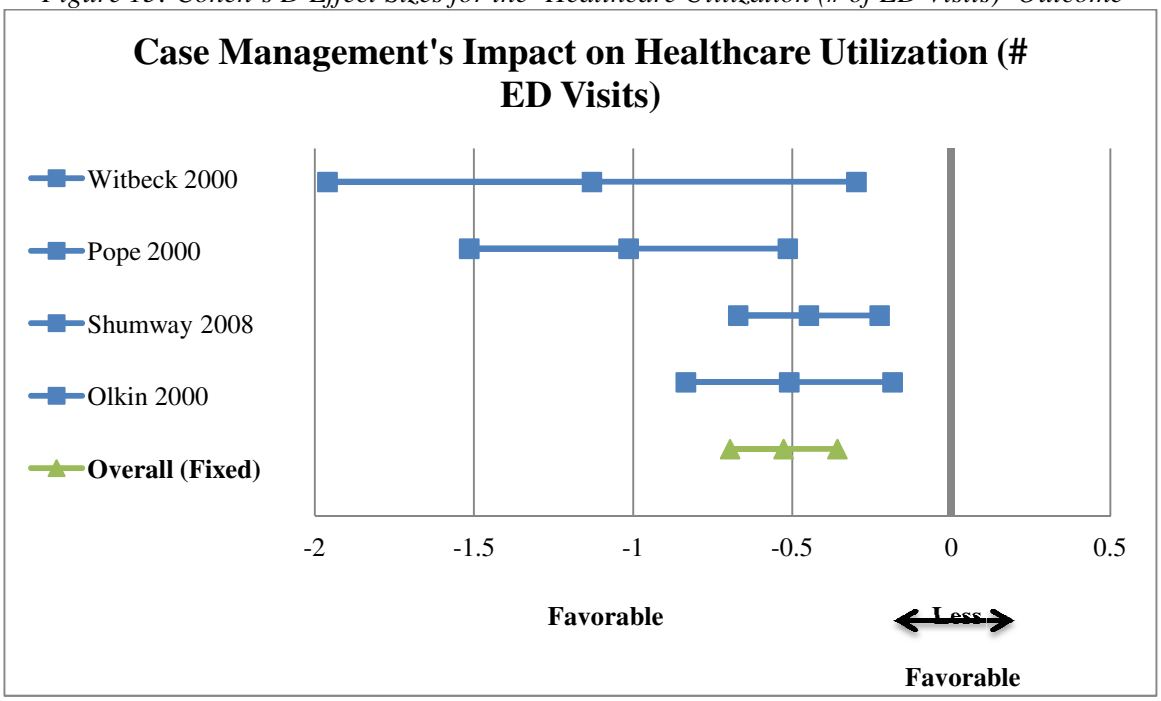
[36] Again, this is due to inverse variance weighing; for more information, see footnote 3

Table 20: Study Characteristics with 'Healthcare Utilization (# of ED Visits)' Outcome

Primary Author Last Name	Year Published	Total Sample Size	Treatment Group	Control Group
Olkin	2000	106	Post Case Management	Pre Case Management
Shumway	2007	252	Case Management	Usual Care
Pope	2000	48	Post Case Management	Pre Case Management
Witbeck	2000	18	Case Management	No Case Management

Effect sizes for each study are computed, as well as an overall effect size[37] with fixed and random effects. Figure 15 depicts each study's effect size and relative confidence intervals. All four studies have a statistically significant negative relationship between case management and the number of emergency department visits.

Figure 15: Cohen's D Effect Sizes for the 'Healthcare Utilization (# of ED Visits)' Outcome



Case management has a moderate to large effect size (D=-0.53**f) for decreasing the number of emergency department visits. The literature synthesized in this meta-analysis suggests that case management is better at decreasing the number of emergency department visits than usual care, with all studies included being in agreement..

[37] Olkin (2000), Pope (2000), and Witbeck (2000) were weighted at 0.9 or 90% due to their quasi-experimental study design without adequate controls.

The above meta-analysis finds that case management overwhelmingly decreases the number of emergency department visits. However, not all collected studies support this claim. One study that failed to be featured due to a lack of appropriate information for a meta-analysis was conducted by Barnett (2006). Data presented by Barnett (2006) shows that the number of emergency department visits, the number of days hospitalized, and the number of hospital visits are not statistically different from a case management treatment group and a usual care treatment group. To drive this point further, Barnett (2006) also examines relative differences in public health costs. That same analysis fails to show any statistically significant difference in healthcare costs between these two groups as well, for both emergency department and hospital costs. While the number of visits, days hospitalized, and costs decreased for the case management group in each scenario, the lack of significance jeopardizes that finding, suggesting that chance or study design may have contributed to that outcome. Thus, while the meta-analysis supports the notion that case management decreases healthcare utilization, there is literature that suggests alternate findings.

Criminal Justice (Arrested)

Four studies report whether a study participant had been arrested after receiving case management. The sample sizes of the studies range from 77 to 681 participants. Study characteristics are as follows:

Table 21: Study Characteristics with 'Arrested' Outcome

Primary Author Last Name	Year Published	Total Sample Size	Treatment Group	Control Group
Godley	2010	77	Post Case Management	Pre Case Management
Needles	2006	511	Jail + Community Services (females)	Jail Services Only (females)
Prendergast	2011	681	Traditional Case Management	Standard Referral
Siegal	2002	449	Case Management	No Case Management

Effect sizes for each study are computed, as well as an overall effect size[38] with fixed and random effects. The effect sizes are depicted in Figure 16 in the log odds format. According to Figure 16, there appears to be little significant impact of case management on arrests. One study found a significant negative impact on the odds of incarceration. Three studies are not statistically significant.

[38] Godley (2010) and Siegal (2002) were weighted at 0.9 or 90% due to their quasi-experimental study design without adequate controls and reliance on only self-report data, respectively.

Figure 16: Log Odds Effect Sizes for the 'Arrested' Outcome

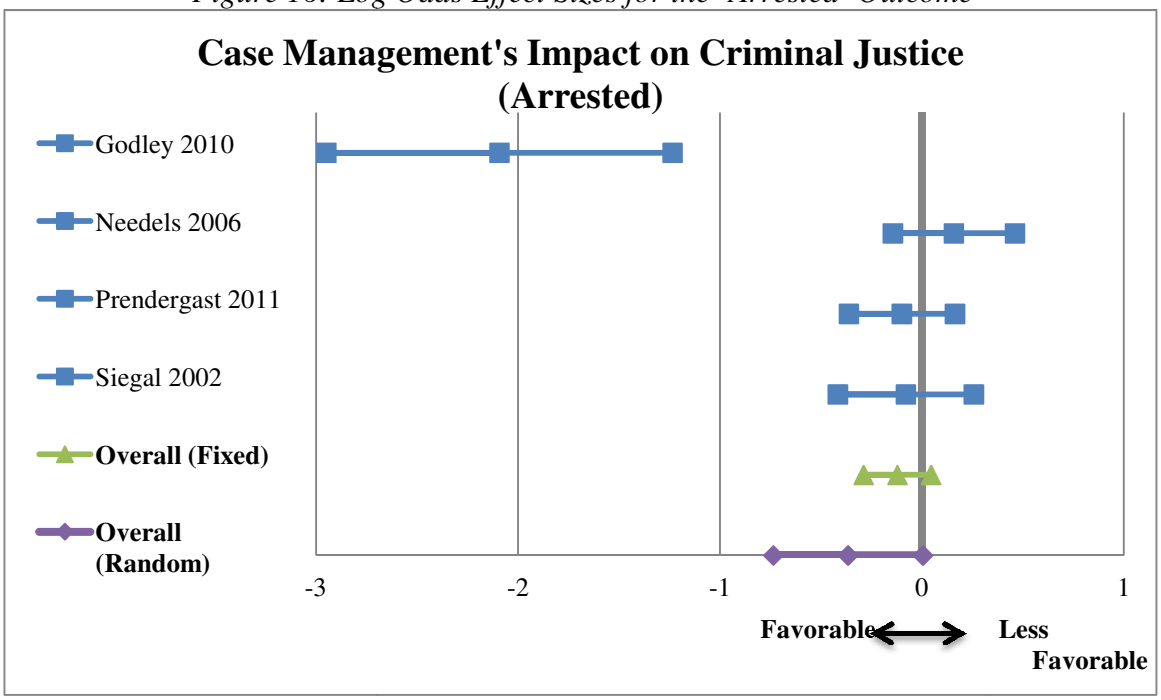


Figure 16 illustrates that the overall effect size is insignificant; no definitive relationship between case management and likelihood of arrest can be established; although Godley's study suggests a rather strong impact, the other studies in the sample found no clear relationship.

Treatment Engagement (Participating in Treatment)

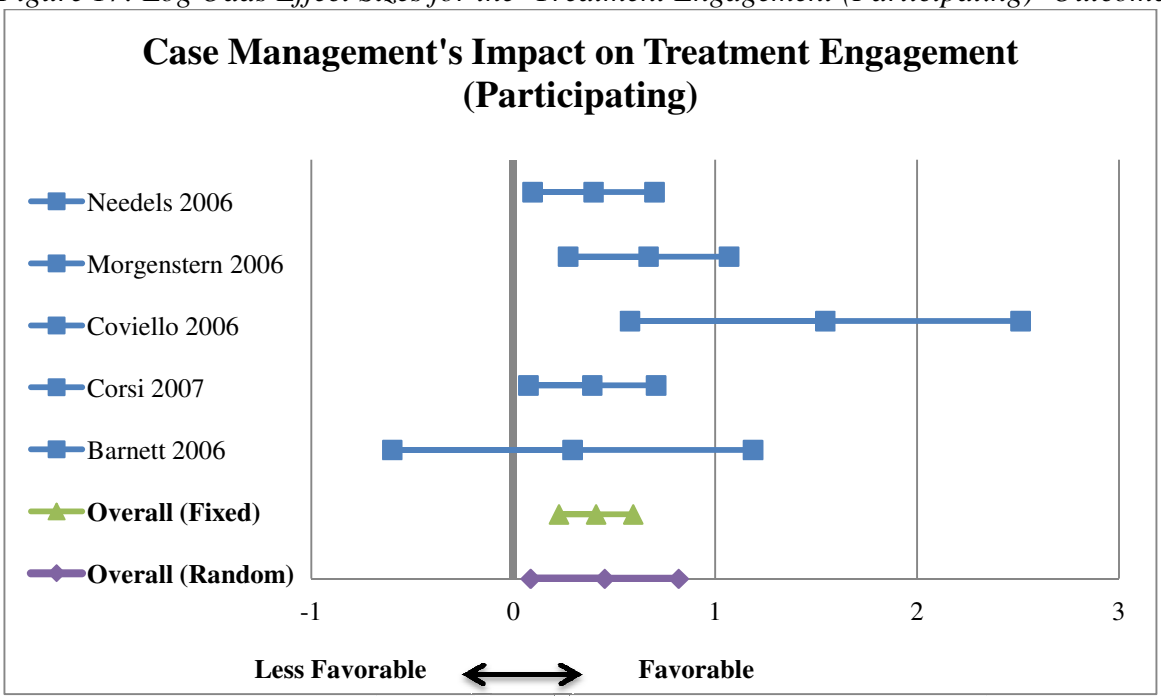
Five studies report whether case management had an impact on the odds of treatment participation. The sample sizes of all four studies range from 104 to 339 participants. Study characteristics are as follows:

Table 22: Study Characteristics for 'Treatment Engagement (Participating)' Outcome

Primary Author Last Name	Year Published	Total Sample Size	Outcome Measured	Treatment Group	Control Group
Barnett	2006	64	Any Methadone Service	Case Management	Usual Care
Corsi	2007	491	Treatment Entry	Case Management	No Case Management
Coviello	2006	122	Return to Treatment	Outreach Case Management	Passive Referral
Morgenstern	2006	291	Sessions Attended	Intensive Case Management	Usual Care
Needles	2006	511	Participated in 1+ Treatment	Jail + Community Service (females)	Jail Service Only (females)

Effect sizes for each study are computed, as well as an overall effect size[39] with fixed and random effects (Figure 17). Four studies have a significant positive impact on treatment engagement; one has no significant relationship..

Figure 17: Log Odds Effect Sizes for the 'Treatment Engagement (Participating)' Outcome



The overall effect size is positive and significant. Converting to an odds ratio, , OR= 1.57**, means that across all the selected studies, the odds of treatment participation for those receiving case management are 1.57 times (57%) that of those in control groups; a small to moderate effect under Cohen's D (D=0.45**) for increasing treatment participation, when compared to control groups. The literature in this analysis is in general agreement that case management is better at increasing the odds of participating in treatment than usual care, with a small to moderate impact.

Conclusion

Overall, a meta-analysis examining the impact of case management is mixed. Case management has better healthcare utilization (moderate to large) and treatment engagement outcomes (small to moderate) than control groups. However, case management does not seem to have better abstinence, duration of abstinence, and criminal justice outcomes than control groups. Studies with employment outcomes do not contain appropriate information to be included in the analysis. What is more, when compared to other wraparound and medication assisted treatments, case management appears to have the "biggest" magnitude of effect for increasing treatment engagement.

However, before case management is written off as useless for abstinence or criminal

[39] All studies were weighted by a factor of 1, except for Barnett (2006) and Corsi (2007)—the former relied on quasi-experimental data without adequate controls (weight=0.9) and the latterrelied on quasi-experimental data without adequate controls and self report data only (weight=0.8).

justice outcomes, further research is required. For instance, interviews with case managers could provide valuable insight into the effectiveness of this wraparound option—similarly to the need to gather research that conducted qualitative interviews with telephone managers for continuing care. Hence, qualitative studies should be explicitly explored, as well as quantitative studies that, while not containing the data necessary for meta-analysis, can lend further expertise.

Wraparounds: Peer Mentoring

History has shown us that peer-to-peer education and example can bring about positive behavior change in the realms of justice, equality, and health (Albert, 2012). In recent years, research has focused on the impacts that peer mentoring has on substance abuse outcomes, specifically in substance-dependent youth, veteran, and HIV-positive populations. A peer-mentor approach allows for communication and understanding in a high-risk environment with less perceived judgement (Mackenzie et al., 2012). Social network and empowerment theories help explain how peer mentoring allows for the connection of those with shared experiences to rely on one another for support (Mackenzie et al., 2012). The use of peer mentors in an empowering technique that utilizes "individuals who are respected and recognized as natural helpers, educators, and role models" (Nyamathi et al., 2001, p. 411). Factors that contribute to the success of a peer approach include the validation that peers have share the same experiences, a boost in self-esteem through the sense of usefulness to one another, the development of a sense of togetherness and acceptance, and the challenging of one another to develop new behaviors (Hritz & Gabow, 1997).

In Denver, CO, a study on youth gang activity utilized the peer approach along with the self- and group-help principles of Alcoholics Anonymous (AA) and found an increase in school involvement and employment, and a decrease in arrests, violence, and gang activity via self-report data (Hritz & Gabow, 1997). A qualitative study of HIV-positive injection drug users found that those participating in peer mentorship developed a sense of community by sharing personal experience and possessing a shared identity as a stigmatized population (Mackenzie et al., 2012). Additionally, peer counseling may complement formal treatment programs by mitigating some of the patient's issues with trust and communication while decreasing reliance of staff resources (Tracy et al., 2011). Peer mentoring has been shown anecdotally to be "effective in promoting behavior change by improving coping skills in dealing with difficult situations where unsafe behaviors commonly are used" (Nyamathi et al., 2001, p. 411).

Methods

A total of 17 studies were located searching the terms "peer mentoring and substance abuse" and "peer mentor and substance abuse outcomes", via previously collected literature, and the Washington State Institute of Public Policy's previous analysis. Six of those studies did not have a control or comparison groups included and were not eligible for meta-analysis. Of the remaining 11 studies, six contained adequate information to be included in the meta-analysis. One study, Rhodes et al. (2005), measured impacts of peer mentoring on two distinctly different samples in relation to a control group. This study was split and counted as 2 separate studies. The total number of studies utilized in the meta-analysis was 8 studies, which generated 18 effect sizes.

Standardized mean difference (Cohen's D) effect sizes, as well as odds ratio effect sizes, were calculated for differing treatment outcomes. If a study generated a standardized mean

difference effect size, it was converted to an odds ratio effect size using the online Effect Size Calculator[40]. These conversions represent an estimated odds ratio effect size. This was done in order to compare effect sizes across common outcomes.

Results

Eights studies measured the impacts of peer mentoring on substance abuse outcomes, including drug use, treatment retention, health, and violence. Of these outcomes, overall effect sizes were calculated for the outcomes alcohol use and drug use. Additionally, an average of the two studies calculating treatment retention and unprotected sex were generated for an overall effect size; however, no further analysis was done due to the limited number of studies available. Table 1 displays a summary of all effect sizes computed, as well as overall effect sizes for those outcomes that generated further analysis. Overall effect sizes are computed using a random effects model in Table 23.

Table 23: Summary of Effect Sizes

Parameter	No. of Studies	Effect Size (OR)	90% Confidence Interval (OR)
All Studies	8	--	--
Substance Use Outcomes			
Alcohol Use	3	0.77*	0.63 – 0.87
Drug Use	6	0.68**	0.49 – 0.82
Treatment Adherence Outcomes			
Treatment Retention	2	1.20_F	0.90 – 1.58
Health Outcomes			
Adherence to HIV Meds	1	1.26	0.98 – 1.61
Hospitalizations	1	3.11**	1.47 – 6.60
Needle Sharing	1	0.87	0.54 – 1.41
Unprotected Sex	2	1.07_F	0.78 - 1.47
Utilized HIV Care	1	1.30	0.79 – 2.14
Other Outcomes			
Violent Behavior	1	0.93	0.75 – 1.15

** denotes statistical significance at the 95% confidence interval, * denotes statistical significance at the 90 % confidence interval. $_F$ denotes a fixed effects model statistic.

Of all the treatment outcomes with three or more studies available for review, the only statistically significant finding was on the treatment outcomes for alcohol use and drug use. The lack of additional statistically significant results could be due to the limited number of studies located for this analysis. This is still a developing approach to treating substance abuse; therefore, we expect to see more research and literature on peer mentoring in the future.

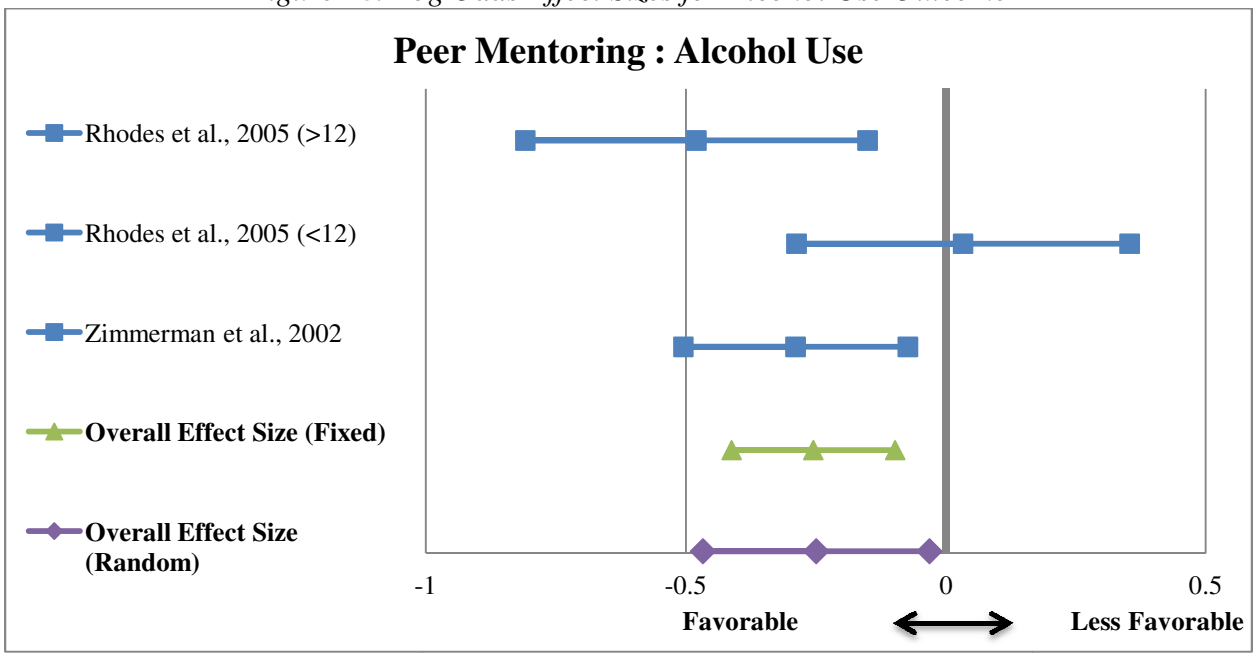
Alcohol Use

Three studies measured the impact of peer mentoring on rates of alcohol use. Alcohol use was measured as a dichotomous variable. This means that treatment participants either used alcohol or did not use alcohol for the duration of the study. Rhodes et al. (2005) split their treatment sample into two groups, which were used as two separate studies. One treatment group contained individuals who had a peer mentor for less than 12 months and the other treatment

[40] Practical Meta-Analysis Effect Size Calculator: http://cebcp.org/practical-meta-analysis-effect-size-calculator/

group contained individuals who had a peer mentor for longer than 12 months. Figure 18 displays the log odds effect sizes for the impact of peer mentoring on the likelihood of alcohol use. Zimmerman et al. (2002) is an estimated effect size. The original effect size was a Cohen's D effect size of -0.16, which indicates a very small negative relationship between peer mentoring and alcohol use. This effect size was converted to an odds ratio effect size for comparison with other studies, and converted to a log odds outcome for Figure 18. All of the study participants in this analysis were youth with or without peer mentors.

Figure 18: Log Odds Effect Sizes for Alcohol Use Outcome



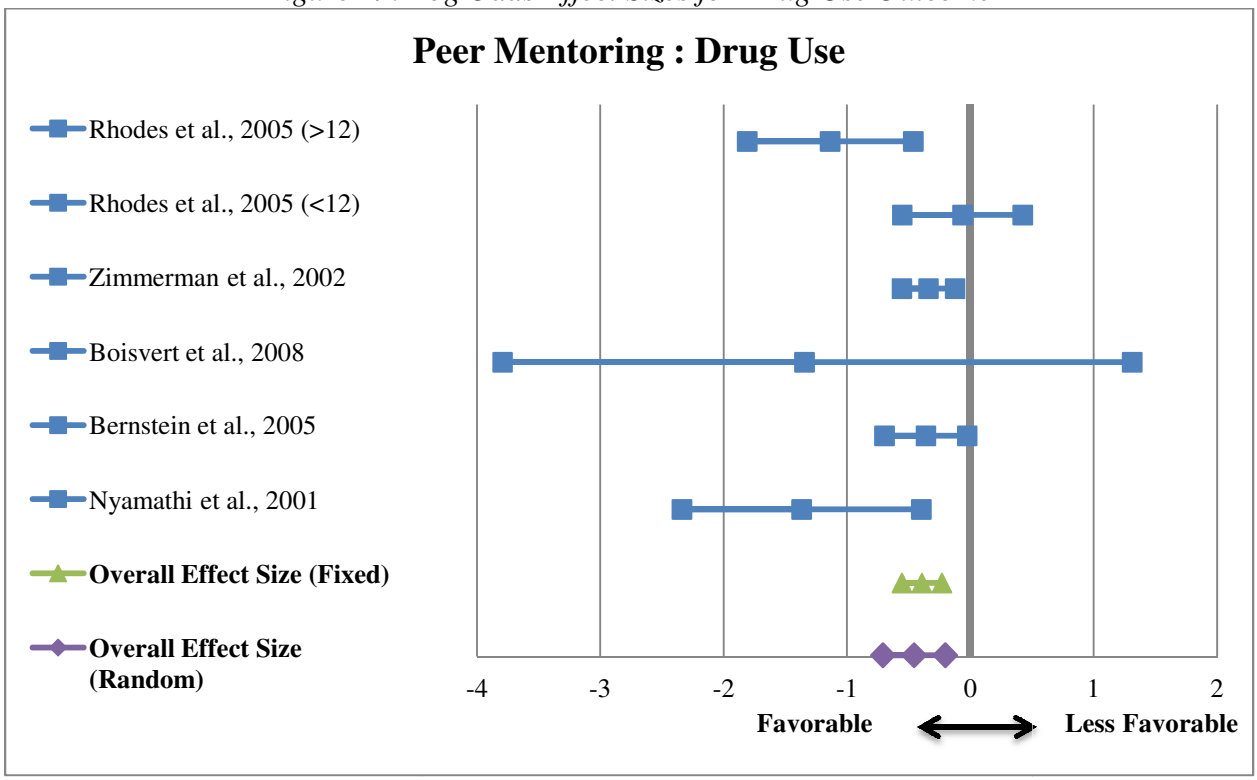
The fixed and random effects models suggest that there is a negative relationship between peer mentoring and alcohol use.

Drug Use

Six studies measured the impact of peer mentoring on drug use outcomes. Zimmerman et al. (2002) measured specifically for marijuana and is also an estimated effect size. The original effect size for Zimmerman et al. (2002) was a SMD effect size of -0.19, indicating a weak negative relationship between peer mentoring and drug use. This effect size was converted to an odds ratio effect size for comparison with other studies, and converted to a log odds outcome for Figure 19. The two effect sizes computed for Rhodes et al., (2012) measured for any drug use (not including alcohol use). Alcohol use was calculated as a separate outcome. Boisvert et al. (2008) was weighted at 0.9 or 90% when calculating the overall effect size. This is due to the study lacking a control or comparison group. This study utilized pre-treatment and post-treatment outcomes. The pre-treatment outcomes for relapse or drug use were used as the control group while the data for the post-treatment was used as the treatment group. Additionally, the sample size was 10, which skews the analysis, potentially overstating the results. The treatment participants of the two Rhodes et al. (2005) studies and Zimmerman et al. (2002) studies were comprised of youth. The additional study participants were adults. Figure 19 is the forest plot

that depicts the log odds effect sizes for each effect size as well as the overall effect sizes for the outcome of drug use.

Figure 19: Log Odds Effect Sizes for Drug Use Outcome



The overall effect size for the random effects model indicates a negative significant relationship between peer mentoring and drug use. The odds ratio overall effect size is 0.68, with a 95% confidence interval of 0.53 – 0.88. This means that those with peer mentors are 0.68 times as likely to use drugs as someone who does not have a peer mentor, or 32% less likely.

Other Treatment Outcomes

Additional treatment outcomes were measured in the available peer mentor studies, as displayed in Table 1. However, many of these outcomes did not have three or more studies measure them and were not included in a meta-analysis. This does not mean that the information gathered from these studies is not meaningful. The outcomes of treatment adherence, health, and violence offer a more complete picture of what impacts peer mentoring can have on treatment participants. The treatment outcomes for treatment retention, adherence to HIV medications, needle sharing, unprotected sex, utilized HIV care, and violent behavior were all not statistically significant. However, with additional research, a relationship may be determined between peer mentoring and treatment adherence, health, and criminal justice outcomes. One health outcome, hospitalizations, was determined to have a positive relationship with peer mentoring. This finding doesn't mean that peer mentoring causes an increase in hospitalization. It could be that in the study that reported this finding, something happened where treatment participants needed additional medical attention. Like with other treatment outcomes, additional studies are needed to fully define the link between peer mentoring and hospitalizations.

Conclusion

Despite the limited number of studies available for analysis, important significant findings are found. A relationship between peer mentoring and substance use, both alcohol and drugs, is found to be statistically significant and negative. This means that with the presence of a peer mentor and peer mentor programming, treatment participants are less likely to use drugs and alcohol compared to those who do not have a peer mentor. The formal evaluation of peer mentoring is limited (Nyamathi et al., 2001). With additional research, further evaluation of treatment retention, health, and behavioral outcomes may be done. Additionally, the impact of peer mentoring in conjunction with formal inpatient or outpatient treatment should be explored. The ability of peer mentors to connect with those struggling can help build bonds of trust and promote education through their shared experience (Nyamathi et al., 2001). Peer mentors act as agents of change for those they mentor (Albert, 2012; Mackenzie et al., 2012).

Medication-Assisted: Methadone

Since its development in the 1940's, methadone is one of the most researched and evaluated form of substance use treatment in the field of drug abuse (Bawor et al., 2014; Farrell et al., 1994). Methadone is the most widely used harm reduction technique to handle opioid addiction (Bawor et al., 2014). The traditional stance of abstinence-only drug treatment is not always ideal for those struggling with opioid addiction (Farrell et al., 1994). This is due the impact that opioids have on the human body and a person's brain chemistry (Cherkis, Grim & Shifflett, 2015).This stray from the traditional abstinence-only viewpoint leads methadone to "arouse professional and political controversy" (Farrell et al., 1994, p. 997). Those who use methadone to cope with opioid addiction are not living a drug-free life because of their dependence on methadone to keep addiction symptoms at bay. Methadone is "a synthetic analgesic with the ability to inhibit the euphoric effects of opioids and provide relief of withdrawal symptoms due to its longer duration of action" (Bawor et al., 2014).

Often treatment outcomes with methadone do not include abstinence, but a focus on functioning as close to a normal life as possible (Farrell et al., 1994). Previous research indicates that methadone, along with counseling, social services, and personalized care, can increase the likelihood of success with treatment outcomes (Farrell et al., 1994). Research also notes that methadone dosage may influence research findings. The optimal dosage of methadone is around 50 mg (Farré et al., 2002). Studies that under-dose may introduce bias into study results (Farré et al., 2002). Additionally, most methadone research focuses on use of methadone by males. Methadone maintenance may impact women in different ways than it does with males (Bawor et al., 2014). Regardless of these gaps in the current research, methadone maintenance is associated with "a reduced risk of death and disease, reduced heroin use and involvement in crime, and an improvement in well-being" (Bell & Zador, 2000, p. 188). These benefits can greatly improve an addict's quality of life as well as increase societal well-being.

The cost effectiveness of this treatment has been explored via multiple cost benefit analyses, conducted both in the United States and internationally. In Australia, Moore, Ritter, and Caulkins (2007) found pharmacotherapy maintenance with methadone is more cost effective than residential rehabilitation, or prison. However, for those who were unable to complete treatment, prison with treatment was deemed to the most cost-effective option (Moore et al.,

2007). In terms of health care costs, McCarty et al. (2010) found that those not in treatment, and those in outpatient treatment without methadone maintenance incurred more costs, 62% and 50% more respectively, on their health care plans than those on methadone maintenance. Some methadone maintenance programs utilize incentives in an attempt to motivate patients to continue attending treatment and remaining abstinent. Sindelar, Olmstead, and Pierce (2007) found that incentives for negative urine samples are more cost effective in methadone maintenance than usual care. Another study found that when determining the role of including monetary incentives for continued treatment adherence, those who received incentives were more likely to achieve continuing abstinence than those who did not (Peirce et al., 2006). Variation in treatment administration, including incentives and counseling, can change the price of treatment. However, these variations can offer patients different degrees of benefits when it comes to maintaining abstinence and treatment adherence.

Methods

Articles for the methadone maintenance treatment (MMT) analysis were located via searches in the Oregon State University article databases and Google Scholar. The keywords used for searches included "methadone maintenance," "methadone maintenance treatment outcomes," and "methadone treatment." These searches resulted in the collection of 39 studies, 29 of which were quantitative studies that could potentially be used for meta-analysis. The studies were reviewed based on the presence of the presence of a control or comparison group, made available after 2000, and contained proportion outcomes after a period of time. Thirteen studies contained the necessary information to compute a total of 21 odds ratio effect sizes. One of the included studies was published in 1999, but was included in the analysis.

Results

Of the 13 studies that fit the criteria for analysis, seven treatment outcomes were identified in the studies. Drug use, employment, and rate of arrest contained enough studies in order to analyze thoroughly. Treatment retention was not analyzed further due to the wide variation in the manner that retention is measured. The overall effect sizes in Table 24 are in odds ratio form[41]. Drug use and employment were found to not have a statistically significant relationship with methadone maintenance treatment. However, arrest was found to have a significant relationship with methadone maintenance.

[41] Effect sizes are not statistically significant if they include 1.

Table 24: Summary of Effect Size Results

Parameter	No. of Studies	Effect Size (OR)	90% Confidence Interval (OR)
All Studies	13	--	--
Substance Use Outcomes			
Drug Use	9	0.55	0.26 – 1.17
Vs. No Treatment	4	0.29	0.04 – 2.24
Treatment Adherence Outcomes			
Treatment Entry	1	0.14**	0.08 – 0.26
Treatment Retention	3	--	--
Health Outcomes			
Emergency Room Episodes	1	0.58**	0.47 – 0.72
Hospitalizations	1	0.69**	0.53 – 0.89
Criminal Justice Outcomes			
Arrest	4	0.18*	0.04 – 0.90
Employment Outcomes			
Employment	5	1.31	0.68 – 2.51

The studies that measured 'Treatment Retention' used differing requirements to determine retention, therefore it was not included in the results section and further comparison was not conducted

Despite the lack of significant findings, further analysis was done on the treatment outcomes of drug use, employment, and arrest. While none of these analyses produced a statistically significant result, the findings can shed light on limitations in current research and new trends in methadone maintenance research.

Drug Use

Nine studies measured drug use reported after a follow-up time. Three studies are international and utilize study participants outside of the United States. This is important, due to the policy and public perception differences regarding substance abuse in countries outside of the US. Four of the included studies were conducted in correctional facilities. Two of the correctional studies were conducted outside of the U.S. Out of the nine studies, three measure heroin use, two measure opiates, and four measure the use of opioids. Opiates are naturally occurring drugs from opium and opioids are the synthetic versions of these drugs. The studies were published between 1999 and 2015. The time lapsed in between the initial start of the study and the follow-up to measure drug use range from 1 month to 1 year. The total sample size of each study ranges from 60 study participants to 483 study participants.

Table 25: Study Characteristics with 'Drug Use' Outcome

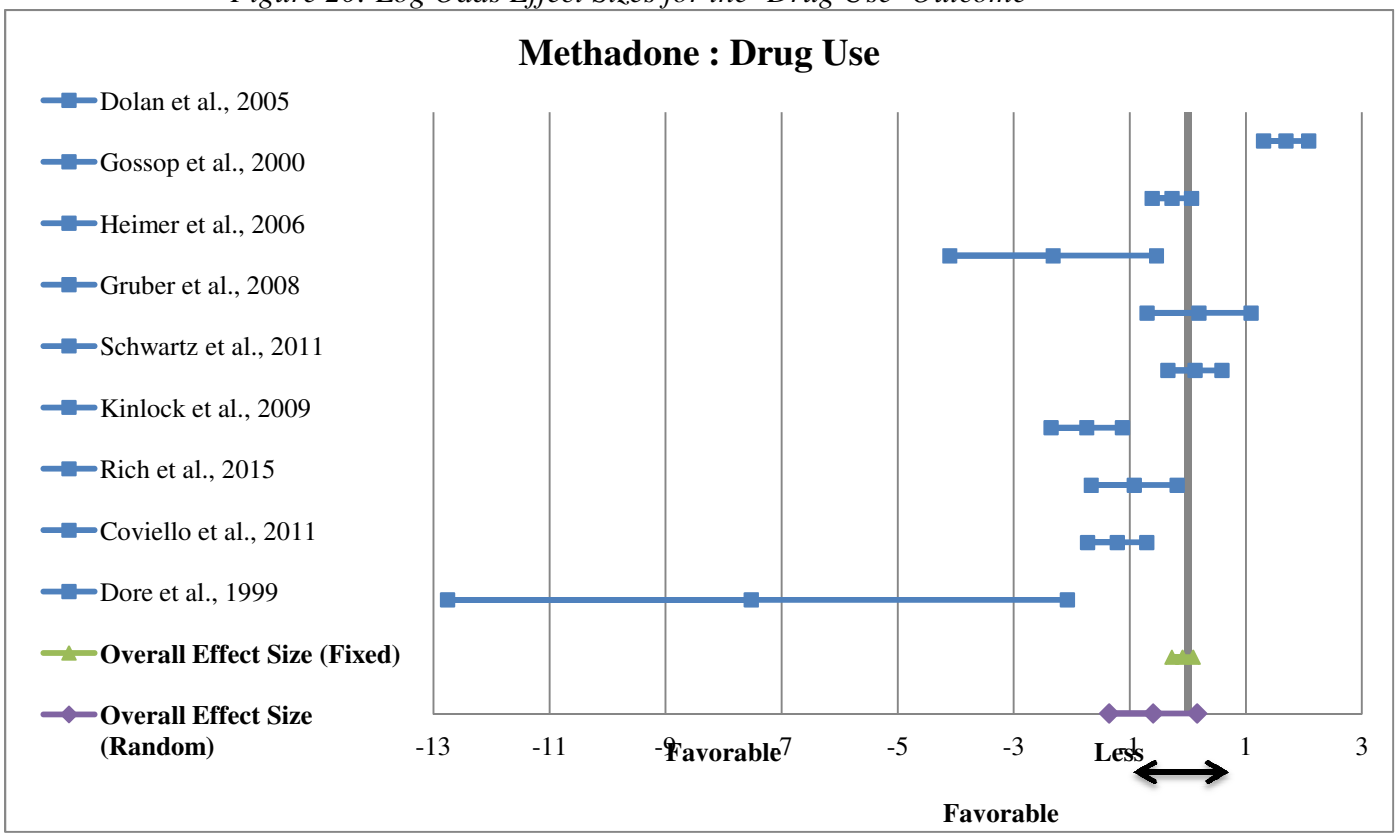
Primary Author Last Name	Year Published	Follow-up Duration after Beginning Treatment	Total Sample Size (N)	Type of Drug Use Measured
*Dolan et al.***	2003	5 months	382	Heroin
Gossop et al.	2000	1 year	483	Heroin
*Heimer et al.***	2006	11 months	60	Heroin
Gruber et al.	2008	6 months	76	Opiates
Schwartz et al.	2011	4 months	203	Opiates
Kinlock et al.	2009	1 year	141	Opioids
Rich et al.	2015	1 month	197	Opioids
Coviello et al.	2011	1 year	230	Opioids
Dore et al. **	1999	3 months	98	Opioids

** = International Study
Italics = Study based in a correctional facility

An effect size for each study was computed, as well as an overall effect size measuring the impact of methadone maintenance on drug use. All studies were weighted equally with the exception of Coviello et al. (2011), and Dore et al. (1999)[42]. Figure 20 displays the effect size of each study in log odds format with the confidence interval surrounding it. The overall effect size is displayed with a fixed effect model and random effects model. The random effects model is the more conservative estimate[43]. Three of the studies were not statistically significant. One study had a statistically significant positive relationship between methadone maintenance and drug use and five studies had a statistically significant negative relationship.

[42] Coviello et al. (2011), and Dore et al. (1999) were weighted at 0.9 or 90% for the overall effect size. This weighting was applied due to the studies quasi-experimental design and pre-post design, respectfully.
[43] The random effects model decreases the likelihood of a type 1 error by inflating the standard errors.

Figure 20: Log Odds Effect Sizes for the 'Drug Use' Outcome



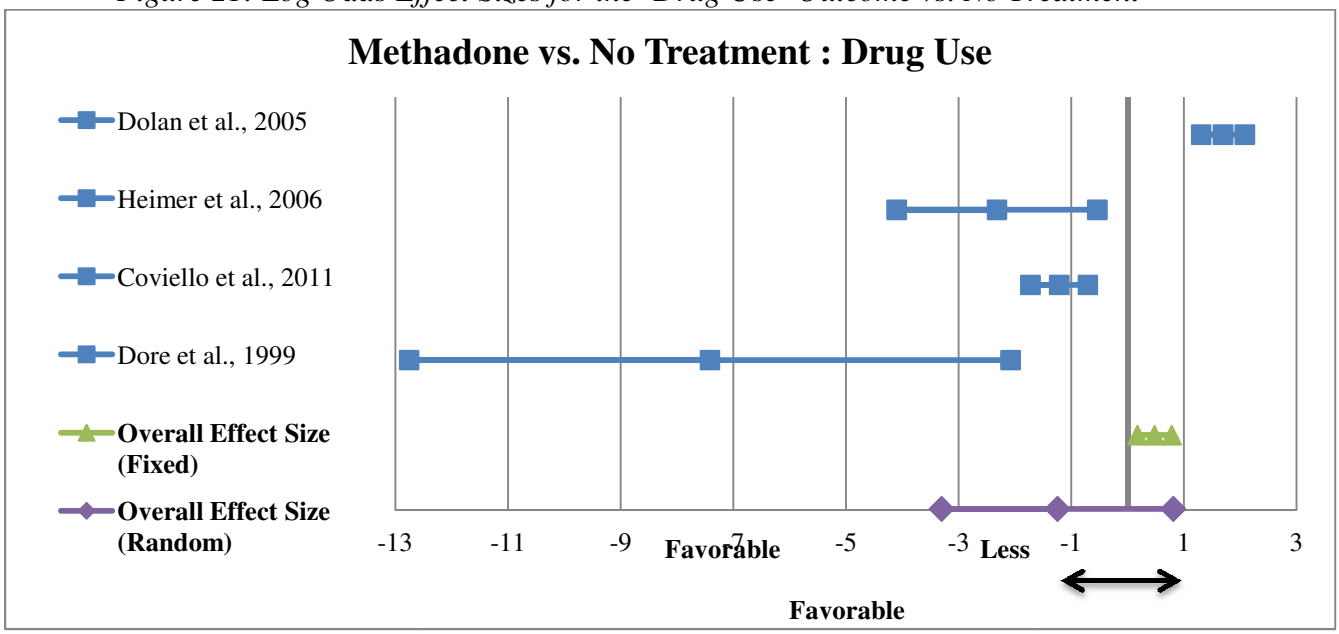
The overall effect sizes both indicate any relationship between methadone maintenance and drug use is non-significant. However, the treatment and control group of each study in this analysis were not uniform. Traditionally in a meta-analysis, the control and treatment groups are uniform throughout all studies included in the analysis. In this case the comparison or control group varied; see Table 26:

Table 26: Treatment & Control Groups by Study for Drug Use

Primary Author Last Name	Year Published	Treatment Group	Control Group
Dolan et al.	2003	MMT	No Treatment
Gossop et al.	2000	MMT	Methadone Reduction
Heimer et al.	2006	MMT for Inmates	No Treatment
Gruber et al.	2008	MMT w/ Counseling	Methadone Detoxification
Schwartz et al.	2011	MMT	Interim MMT
Kinlock et al.	2009	Counseling w/ MMT Transfer	Counseling In-prison
Rich et al.	2015	MMT	Tapered MMT
Coviello et al.	2011	Re-enrolled in MMT	No treatment
Dore et al.	1999	MMT	No Treatment (pre-test)

The wide variation in treatment and control groups could account for the wide variation in effect sizes and lack of statistically significance in the overall effect size. This demonstrates a limitation in the analysis of methadone's impact on treatment outcomes. When isolating the control group to those that did not receive treatment or those that received treatment as usual, the findings are consistent with all studies. Figure 21 shows the impacts of methadone on drug use compared to patients with no treatment.

Figure 21: Log Odds Effect Sizes for the 'Drug Use' Outcome vs. No Treatment



Four studies had control or comparison groups that received no treatment. The relationship between methadone and drug use is still not statistically significant. This could be due to a variety of factors; i.e., differences in the study design, different populations, or so forth. Overall we cannot definitively determine if a relationship exists between methadone maintenance and drug use.

Employment

Three studies included outcome variables that measured whether study participants were employed after a follow-up. The total sample size of these studies ranges from 96 to 7313, and the follow-up duration ranges from 6 months to 10 years. The characteristics for the studies included in this analysis are in Table 27. The studies that reported employment after methadone maintenance treatment were published between 1999 and 2011. Similar to the above analysis of 'drug use', the treatment and control groups for this analysis are not uniform across the four studies. While MMT is the primary treatment, variation exists across the control or comparison group, as well as immense follow-up time differences

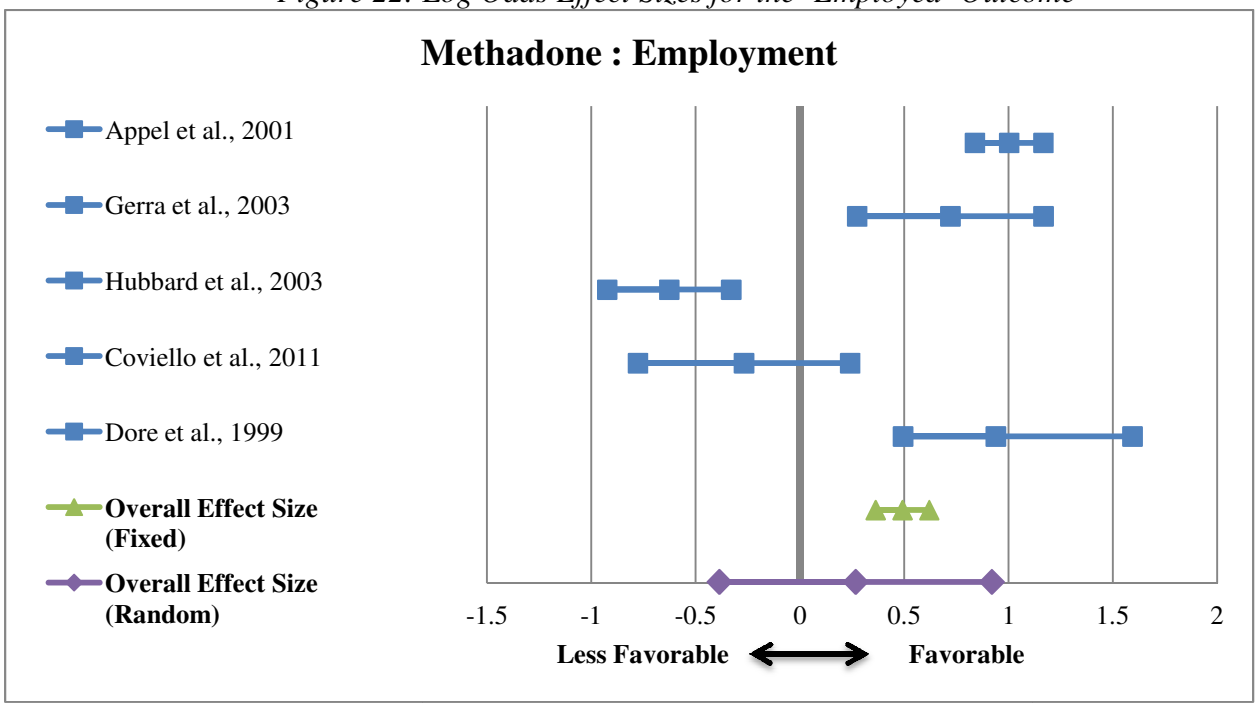
Table 27: Study Characteristics with 'Employed' Outcome

Primary Author Last Name	Year Published	Follow-up Duration after Beginning Treatment	Total Sample Size	Treatment Group	Control Group
Appel et al.	2001	10 years	7313	Continuous MMT	Treatment Drop-Out (6 mo.)
Gerra et al.	2003	1 year	265	Responded to MMT	Did not respond to MMT
Hubbard et al.	2003	5 years	1393	Outpatient MMT	Long-term residential/Outpatient abstinent/Short-term inpatient
Coviello et al.	2011	1 year	230	Re-enrolled in MMT	No treatment
Dore et al.	1999	6 months	96	MMT (post-test)	No Treatment (pre-test)

Each study has been weighted at 0.9 or 90% due to study design[44]. Figure 1 depicts the effect sizes for each study, as well as the weighted overall effect size with fixed and random effects in log odds. The weighting was utilized to compute the overall effect size. Weighting was not applied to the individual effect sizes of each study, as displayed in Figure 22. Three studies report a statistically significant positive relationship between methadone maintenance and employment, one study has a significant negative relationship and one study was not statistically significant.

[44] Appel et al. (2001) and Gerra et al. (2003) utilized a quasi-experimental design with the use of a comparison group rather than a control group. Hubbard et al. (2003) was an experimental design, there was no designated control group. To generate a comparison group, the three treatment group findings outside of the methadone maintenance treatment group were averaged to stand in as the comparison group. This generates a biased comparison group because the participant characteristics were not equivalent across the treatment and comparison groups. Dole et al. (1999) utilized a pre-post test study design without a formal control group.

Figure 22: Log Odds Effect Sizes for the 'Employed' Outcome



The fixed effects model for the overall effect size is statistically significant and reports a positive relationship between methadone maintenance and employment. However, the more conservative random effects model shows a relationship that is not statistically significant. Table 1 indicates that the overall effect size for methadone's impact on employment is an odds ratio of 1.31, with a 90% confidence interval of 0.68 - 2.51. With more effect sizes, the random effect size model may become statistically significant. The variation in study outcomes also suggests that further research, with more similar control groups, would be highly beneficial.

Arrest

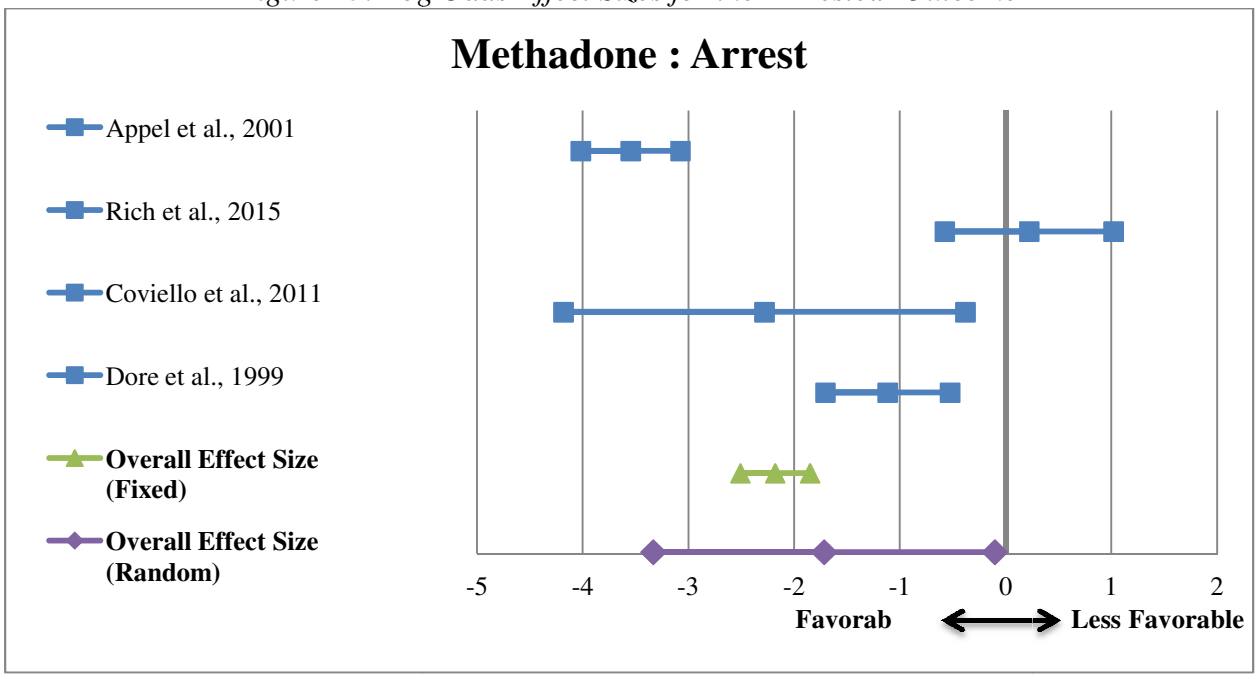
Four studies reported whether a study participant had been arrested after entering methadone maintenance treatment. The sample sizes of all three studies ranges from 96 to 7313 participants. Study characteristics for these studies are in Table 28. The studies were published from 1999 to 2015. The time of follow up after the initial treatment ranges from 1 month to 10 years. Similar to the above analysis of 'drug use', the treatment and control groups for this analysis are not uniform across the three studies. While MMT is the primary treatment, variation exists across the control or comparison group

Table 28: Study Characteristics with 'Arrested' Outcome

Primary Author Last Name	Year Published	Follow-up Duration after Beginning Treatment	Total Sample Size	Treatment Group	Control Group
Appel et al.	2001	10 years	7313	Continuous MMT	Treatment Drop-Out (6 mo.)
Rich et al.	2015	1 month	197	MMT	Tapered MMT
Coviello et al.	2011	1 year	230	Re-enrolled in MMT	No treatment
Dore et al.	1999	6 months	96	MMT	No treatment (pre-test)

Effect sizes for each study were computed, as well as an overall effect size with fixed and random effects. The effect sizes are depicted in Figure 23 in the log odds format. Three studies were weighted when computing the overall effect size[45]. Three studies have a significant negative relationship between MMT and being arrested. One study was not statistically significant.

Figure 23: Log Odds Effect Sizes for the 'Arrested' Outcome



Overall, the fixed effects model is statistically significant and the relationship between MMT and likelihood of arrest are negatively related. When random effects are accounted for, the

[45] Appel et al. (2001) and Coviello et al. (2011) were weighted at 0.9 or 90% due to their quasi-experimental design. Dore et al. (1999) was also weighted at 0.9 or 90% due to the pre-post test design of the study, which lacked a traditional control group.

relationship remains statistically significant at the 90% confidence level. This could be due to the small number of studies included in this analysis. The odds ratio effect size for the relationship between methadone maintenance is 0.18 with a 90% confidence interval of 0.04 – 0.90 (See Table 1). In terms of a percent change, those on methadone maintenance are 82% less likely to be arrested than those participants not on methadone maintenance.

Conclusion

The above analysis indicates that the likelihood of drug use, employment, and employed are not significantly related to methadone maintenance. This could be due to the differences in treatment and control conditions as well as the small number of studies included in each analysis. Variations in the administrative characteristics of methadone maintenance treatment can also have varying impact on treatment outcomes. It is important to note that there is no "silver bullet" when it comes to treating substance abuse. Methadone with various degrees of counseling or ancillary services may potentially magnify the positive impacts that methadone offers. Additional studies replicating the same treatments and controls will need to be done in order to determine what impacts variations in methadone maintenance have on treatment outcomes. However, the potential for decreased crime outcomes suggest that methadone maintenance can have lasting positive impacts on patients that receive it.

Medication-Assisted: Suboxone

Buprenorphine-naloxone was first approved by the US Food and Drug Administration in 2002 as a pharmacological substitution therapy (Mauger et al., 2014). The therapy is generally used for those with opioid dependence, for either prescription opioids or street opioids, like heroin (Weiss et al., 2011). Buprenorphine is an agonist that has been shown to prevent withdrawal symptoms, while naloxone is an antagonist that helps reduce the potential for misuse (Mauger et al., 2014). Suboxone is the name brand for buprenorphine-naloxone in a 4:1 ratio (Mauger et al., 2014). Physicians in a variety of clinical settings can dispense buprenorphine-naloxone with a special waiver (Tetrault et al., 2012). This allows for flexibility in treatment and the ability of patients with other conditions, such as HIV, can get all of their necessary treatment in one place (Tetrault et al., 2012). Buprenorphine-naloxone is more expensive than other pharmacological substitution therapies, like methadone, but is more flexible when it comes to administration and clinic attendance (Mauger et al., 2014). This flexibility is one of the primary strengths of Suboxone treatment that makes it more desirable than other drug therapies (Sittambalam et al., 2014). Previous studies have found that buprenorphine-naloxone may be most effective when using a multidisciplinary approach (Mauger et al., 2014; Tetrault et al., 2012). This means that the drug therapy is coupled with counseling and recovery support services.

In a cost-benefit analysis of opioid-dependent youth in the United States, buprenorphine-naloxone was compared to tapered detoxification. The analysis found that, "extended BUP treatment relative to brief detoxification is cost effective in the US health-care system for the outpatient treatment of opioid-dependent youth" (Polsky et al., 2010, p. 616). While the upfront cost of treatment was more expensive with buprenorphine-naloxone, the long-term benefits after one year outweighed the initial costs associated with the treatment (Polsky et al., 2010). Another cost benefit analysis, done in Portugal, had similar findings when comparing buprenorphine-naloxone to methadone. In Portugal, methadone treatment is free (Gouveia et al., 2015).

However, given the potential of buprenorphine-naloxone to decrease crime and increase health outcomes in those treated, buprenorphine-naloxone was named as the more desired treatment when compared to methadone (Gouveia et al., 2015). Whether used to treat prescription opioid use or heroin use, Suboxone is allowing patients to get treatment in a flexible manner with the potential to increase positive treatment outcomes.

Methods

Articles for the Suboxone meta-analysis were compiled via Oregon State University library database searches, Google Scholar, and articles from the previous analysis by Washington State Institute of Public Policy Analysis (http://www.wsipp.wa.gov/BenefitCost/Program/287). Articles were limited to the terms "Suboxone" and "Buprenorphine-Naloxone" along with "treatment outcomes" or "clinical trial". Articles that studied the impacts of buprenorphine-alone were not included in this analysis, unless they made up a comparison group with buprenorphine-naloxone being the experimental group. A total of 47 articles were compiled; 20 of these articles contained the information required for meta-analysis. Two of these studies, Kamien et al. (2008) and Ling et al. (2005), contained two distinctly separate populations and were counted as two studies each. Kamien et al. (2008) split their sample into those that were receiving high dose and low dose medication. Ling et al. (2005) split their sample into those receiving treatment at inpatient and outpatient facilities. This brings the total number of studies to twenty-two.

Odds ratio effect sizes were computed for further meta-analysis. Three studies generated Standard Means Differences effect sizes (Cohen's D). These effect sizes were converted to odds ratio effect sizes to allow for further analysis. This generates an estimated odds ratio effect size, not an exact measure. Ling et al. (2005) measured treatment retention in the number of days retained in treatment. Therefore, both effect sizes for the low-dose and high-dose samples are estimations. Additionally, McKeganey et al. (2013) measured abstinence in the number of days a participant was drug-free; this effect size is also an estimation. Effect sizes were calculated for substance use, treatment adherence, and health outcomes.

Results

Twenty-two studies were utilized to determine substance abuse treatment outcomes of those treated with Suboxone. An effect size is calculated for the outcomes measured in each study. The outcomes were split into three categories; substance use, treatment adherence, and health. Table 29 displays an overview of all effect sizes computed. Effect sizes are in odds ratios. Those effect sizes that are statistically significant do not include 1 in their confidence intervals. Those with an effect size less than 1 indicate a negative relationship. Those with an effect size more than 1 indicate a positive relationship.

Table 29: Summary of Effect Size Results

Parameter	No. of Studies	Effect Size (OR)	90% Confidence Interval (OR)
All Studies	22	--	--
Substance Use Outcomes			
Abstinence	14	1.16	0.69 – 1.94
Vs. Methadone	6	0.76	0.47 – 1.24
Vs. Treatment As Usual	4	1.45	0.93 – 2.25
Treatment Adherence Outcomes			
Treatment Retention	15	1.19	0.62 – 2.25
Vs. Methadone	5	0.50**	0.34 – 0.73
Vs. Clonidine	4	6.41**	3.75 – 10.95
Treatment Completion	5	0.84	0.21 – 3.32
Health Outcomes			
Adverse Events	3	0.93	0.58 – 1.50
Emergency Treatment	1	0.86	0.45 – 1.65
ER Visits	1	0.96	0.47 – 1.96
Needle Sharing	1	0.31**	0.16 – 0.60
Non-Condom Use	1	0.84	0.60 – 1.16

Statistically significant findings overall include the effect sizes for needle sharing, and treatment retention when Suboxone is compared to methadone and clonidine. However, only one effect size was computed for needle-sharing; therefore, no additional analysis can be done. Outcomes with three or more effect sizes were further analyzed via meta-analysis. The outcomes of 'Abstinence' and 'Treatment Retention' were further analyzed by different control/comparison groups.

Abstinence

Fourteen effect sizes were computed for the 'Abstinence' outcome. Abstinence refers to those that were drug-free at the time of the follow-up evaluation. Study characteristics are displayed in Table 30. Articles for this analysis were published from 2003 to 2015. The follow-up period after the initial induction into treatment ranges from 14 days to 1 year. The majority of studies utilized urine testing to test for the presence of opioids. The total sample size in these studies ranges from 34 to 2840.

Table 30: Study Characteristics for 'Abstinence' Outcome

Primary Author Last Name	Year Published	Follow-up Duration after Beginning Treatment	Total Sample Size (N)	Type of Drug Use Measured	Control/ Comparison Group
McKeganey et al.	2013	8 Months	34	Heroin	Methadone
Fudala et al.	2003	4 Weeks	218	Cocaine	Placebo
Potter et al.	2014	24 Weeks	705	Heroin	Methadone
Fiellin et al.	2011	1 Year	493	Opioids	*(Pre-Post Design)*
Garcia et al.	2007	30 Days	42	Opioids	Buprenorphine-Naloxone (Treatment Non-Completers)
Kamien et al. (LD)	2008	16 Weeks	134	Opioids	Methadone
Kamien et al. (HD)	2008	16 Weeks	134	Opioids	Methadone
Ling et al. (In)	2005	14 Days	113	Opioids	Clonidine
Ling et al. (Out)	2005	14 Days	231	Opioids	Clonidine
Lucas et al.	2010	12 Months	93	Opioids	Treatment Referral
Proctor et al.	2014	6 Months	2840	Opioids	Methadone
Subramaniam et al.	2011	12 Weeks	152	Opioids	Detox (Treatment as Usual)
Woody et al.	2008	12 Weeks	90	Opioids	Detox (Treatment as Usual)
Piralishvili et al.	2015	12 Weeks	837	Opioids	Methadone

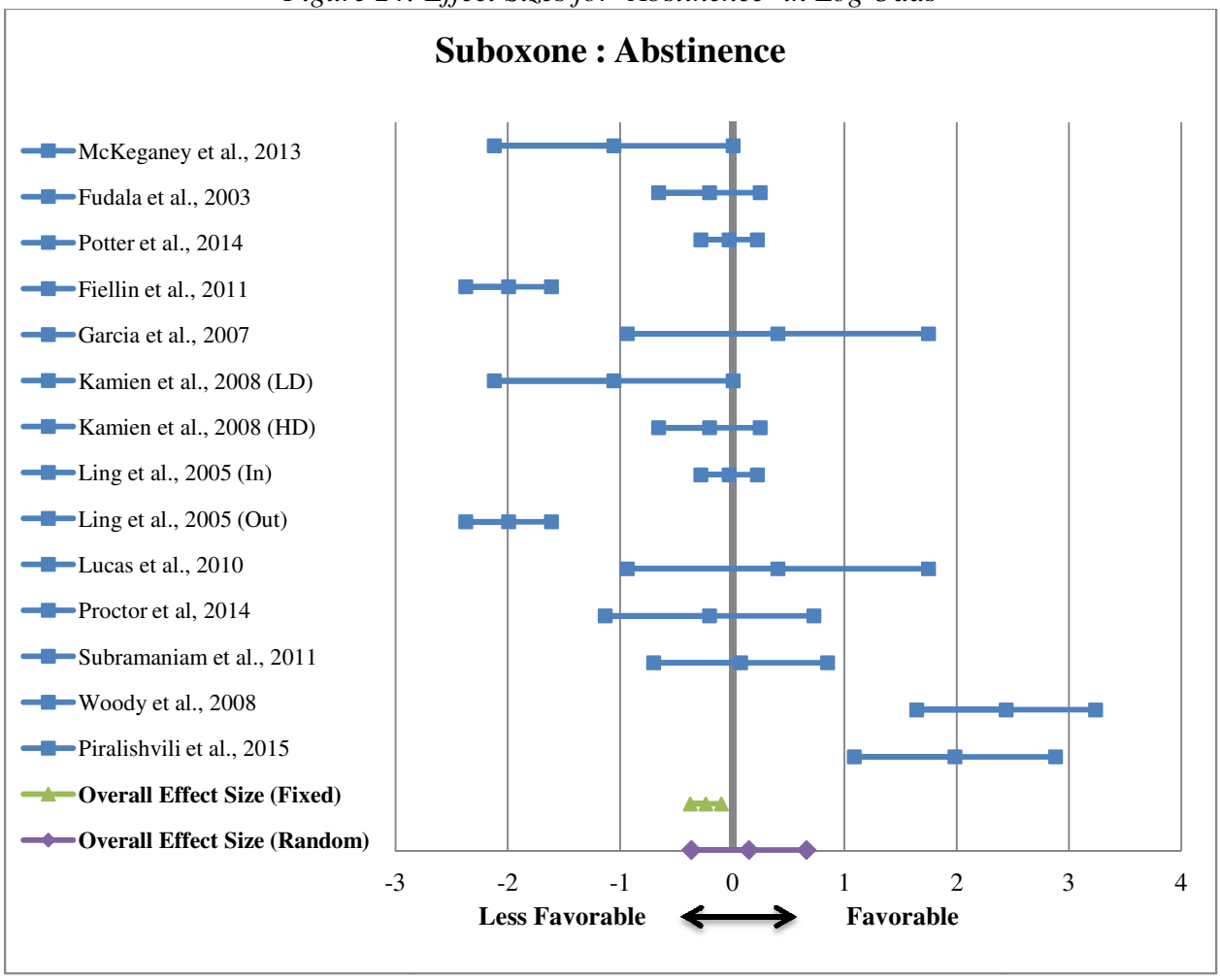
Table 30 also includes information about the control/comparison groups for each study. All studies utilized buprenorphine-naloxone (Suboxone) as the treatment group. As with methadone, there was wide variation in the control or comparison groups for each study. The most common comparison group was those that utilized methadone. Two studies were weighted less when computing the overall effect size[46].

Figure 24 displays the effect sizes for the 'Abstinence' outcome along with the overall effect size in both fixed and random effects. The effect sizes in Figure 1 are in log odds format. This is for ease of interpretation. Those effect sizes that cross the 0 are non-significant. Those that are negative, or less than 0, indicate a negative relationship between Suboxone and abstinence, and those that are in the positive area of the graph indicate a positive relationship. The overall effect size represents the overall impact that Suboxone has on abstinence. The fixed effects model assumes that all studies are homogeneous in nature. The random effects model takes into account any heterogeneity in the studies the effect sizes come from. We utilize the random effects model for our final determination because it is a more conservative figure.

[46] Due to the pre-post design of Fiellin et al. (2011), this effect size was weighted at 0.9 or 90% for the overall effect size. Garcia et al. (2007) was also weighted at 0.9 or 90% due to the lack of a properly specified control or comparison group.

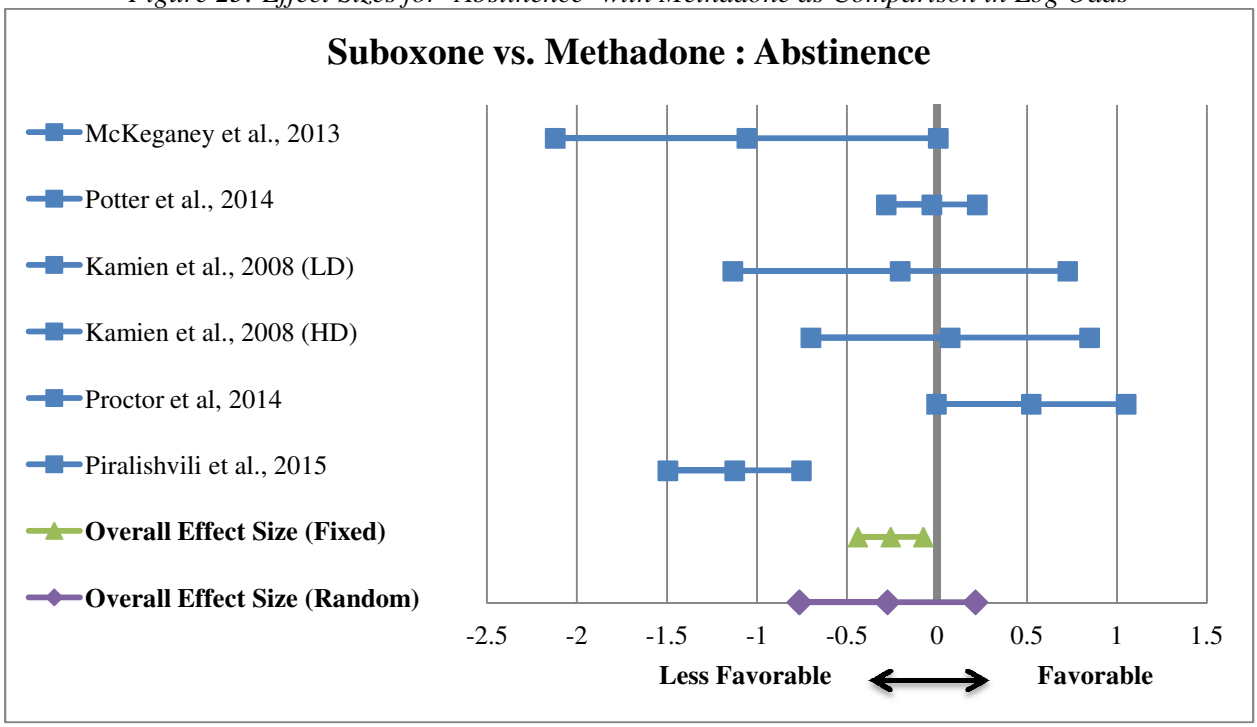
Additionally, the weighting of studies is only applied to the overall effect size, not individual effect sizes as displayed below.

Figure 24: Effect Sizes for 'Abstinence' in Log Odds



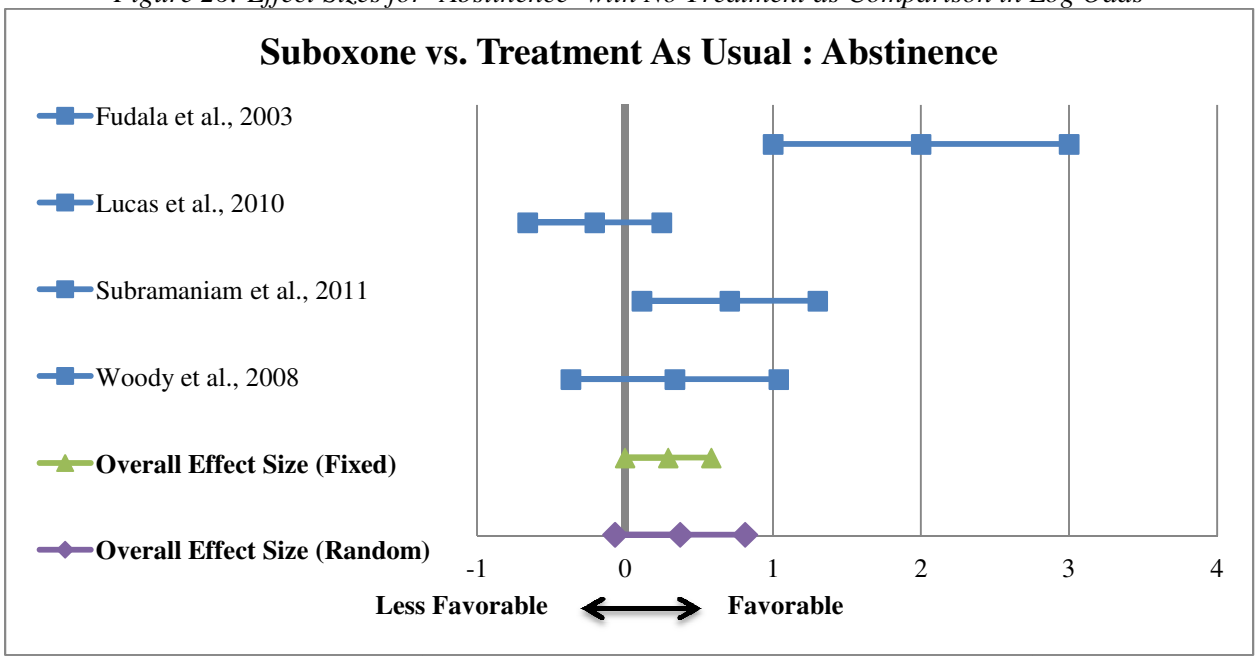
Overall, the impact of Suboxone on abstinence is not statistically significant. The overall effect size for the fixed effects model suggests that there may be a slightly negative relationship, in fact. However, when the heterogeneity of the studies is accounted for in the random effects model, the relationship becomes non-significant. Due to the wide variation in study conditions, this is to be expected. Additional analysis is done by limiting the effect sizes to those with methadone as the comparison group. Figure 25 shows the five effect sizes that had buprenorphine-naloxone as the treatment group and methadone and the control group.

Figure 25: Effect Sizes for 'Abstinence' with Methadone as Comparison in Log Odds



When looking at how Suboxone impacts abstinence when compared with methadone as a comparison, the results are overall statistically non-significant. The fixed effects model suggests that there is a negative relationship between Suboxone and abstinence when compared with methadone. However, that relationship is rendered non-significant when the heterogeneity (variation) of the studies is included. The next treatment outcomes involve how patients adhere to Suboxone treatment whether it is for detoxing or long-term maintenance. Figure 26 utilizes those studies that had a 'treatment as usual' or 'no treatment' comparison or control group. In these four studies, the participants that comprised the control/comparison did not receive any other medication for treatment purposes.

Figure 26: Effect Sizes for 'Abstinence' with No Treatment as Comparison in Log Odds



Overall, the relationship between Suboxone and abstinence is not statistically significant when compared to no treatment, either. Potentially, this could be due to the small number of effect sizes included in the analysis. The relationship between Suboxone and abstinence is not statistically significant in this analysis when all effect sizes are taken together or when separated by the methadone control group or 'treatment as usual' control group.

Treatment Retention

Fifteen effect sizes measured the impact of Suboxone on treatment retention. Treatment retention refers to patients remaining in treatment at the time of a follow-up evaluation. The outcome is measured in binary, meaning treatment participants are either enrolled at the time of follow-up or are not enrolled. Table 31 displays the study characteristics for the 'treatment retention' outcome for Suboxone. The studies were published between 2005 and 2015. The sample size of the studies ranges from 40 to 2840. The time of follow-up ranges from 6 days to 1 year.

Table 31: Study Characteristics for 'Treatment Retention' Outcome

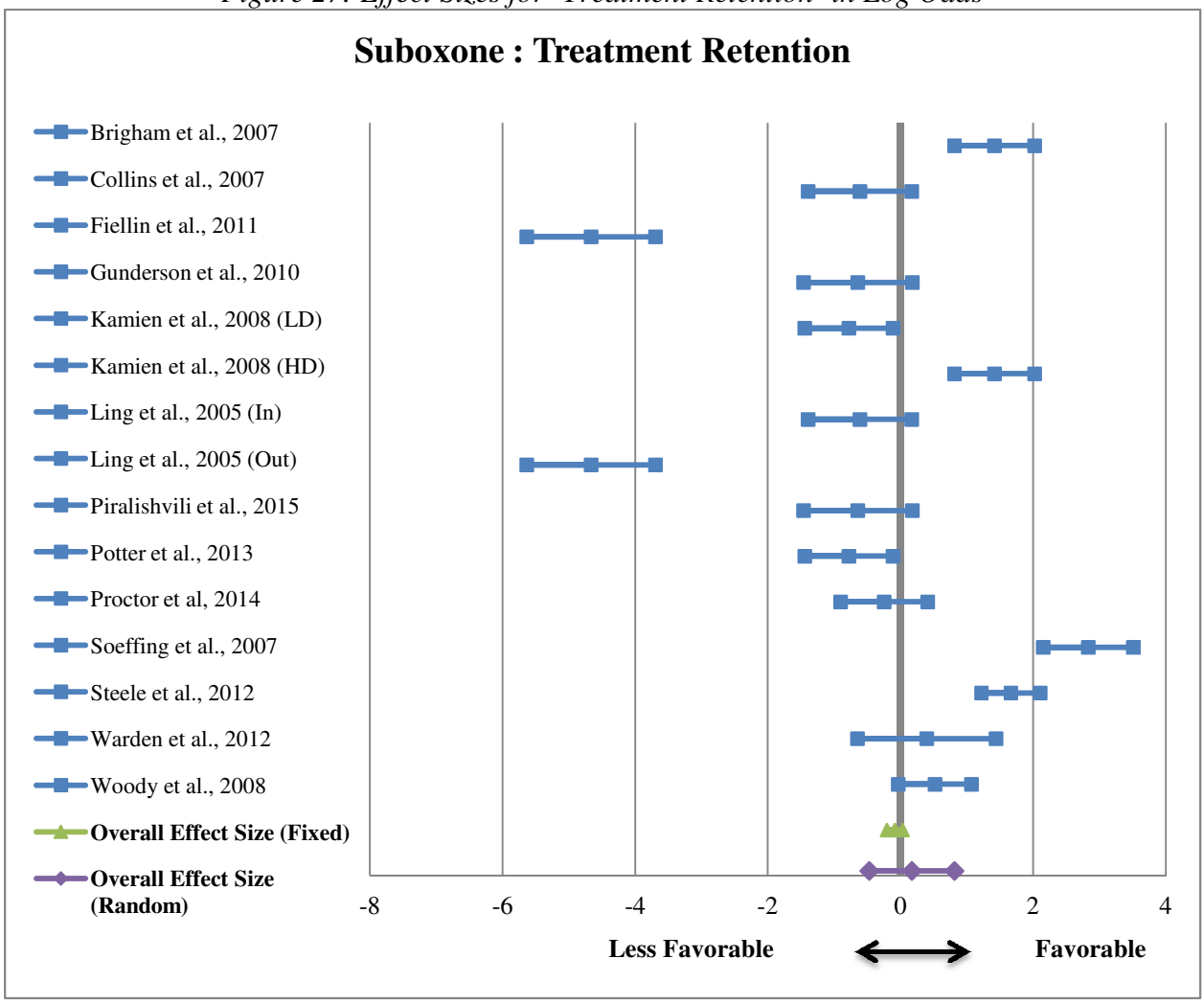
Primary Author Last Name	Year Published	Follow-up Duration after Beginning Treatment	Total Sample Size (N)	Control Group
Brigham et al.	2007	14 Days	291	Clonidine
Collins et al.	2007	3-4 Weeks	75	Comprised Comparison Group
Fiellin et al.	2011	1 Year	606	*(Pre-Post Design)*
Gunderson et al.	2010	4 Weeks	40	*(Pre-Post Design)*
Kamien et al. (LD)	2008	16 Weeks	134	Methadone
Kamien et al. (HD)	2008	16 Weeks	134	Methadone
Ling et al. (In)	2005	14 Days	113	Clonidine
Ling et al. (Out)	2005	14 Days	231	Clonidine
Piralishvili et al.	2015	12 Weeks	80	Methadone
Potter et al.	2013	24 Weeks	1269	Methadone
Proctor et al.	2014	6 Months	2840	Methadone
Soeffing et al.	2007	3 Months	956	Buprenorphine
Steele et al.	2012	6 Days	85	Clonidine
Warden et al.	2012	12 Weeks	152	Detox (Treatment As Usual)
Woody et al.	2008	12 Months	152	Detox (Treatment As Usual)

Each study also has a different control or comparison group. The treatment group for each study was treated with buprenorphine-naloxone. Table 31 also displays the control groups for each study measuring the 'treatment retention' outcome. Weighting was applied to two studies when computing the overall effect size[47]. Four studies utilized Clonidine as a control group and five studies utilized methadone as the control group. Further analysis of these two sets of studies will be explored below.

The individual effect sizes for each study are displayed in Figure 27, along with the overall effect size in the fixed and random effects model. The majority of the effect sizes are relatively close to zero, or crossing zero. Four effect sizes are statistically significant and show a positive impact on treatment retention. An additional four studies are statistically significant and show a *negative* relationship between Suboxone and treatment retention—very mixed results

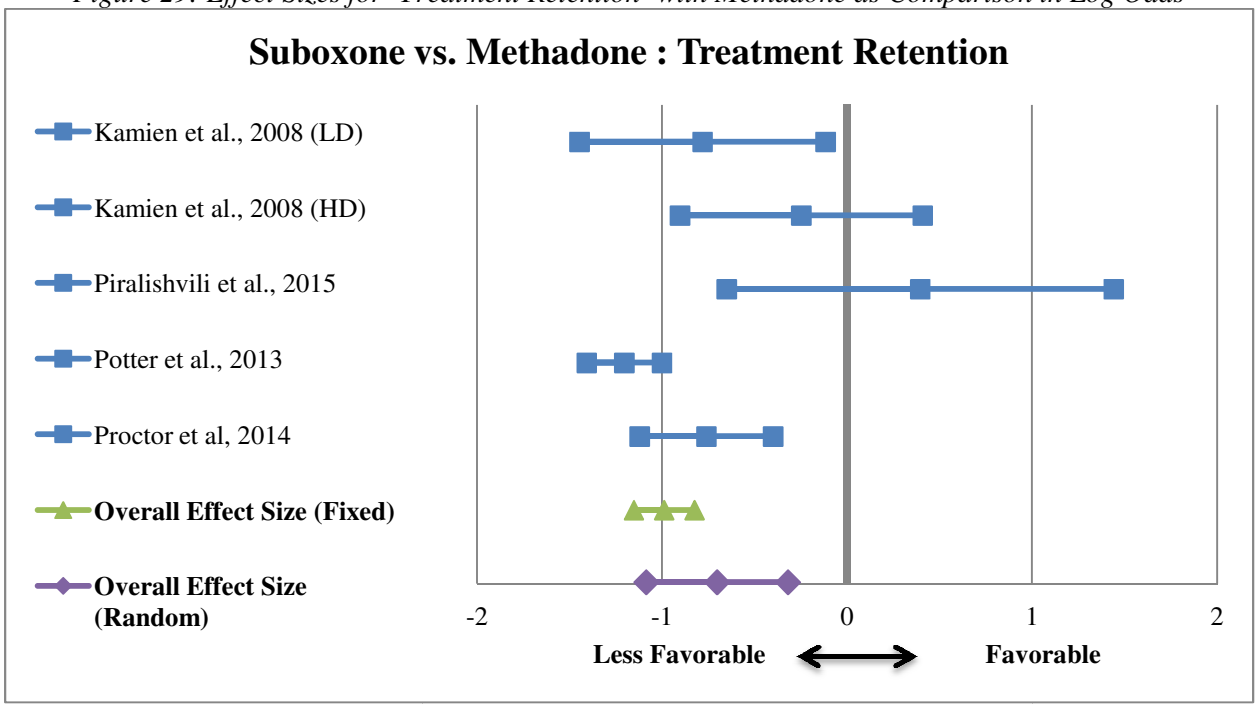
[47] Feillin et al. (2011) and Gunderson et al. (2010) were both weighted at 0.9 or 90% for the calculation of the overall effect size due to their pre-post design.

Figure 27: Effect Sizes for 'Treatment Retention' in Log Odds



Overall, the relationship between Suboxone and treatment retention is not statistically significant. This could be due to the variation in control/comparison groups in each study. Figure 29 looks at the studies that had Suboxone (buprenorphine-naloxone) as the treatment group and methadone as the control/comparison group.

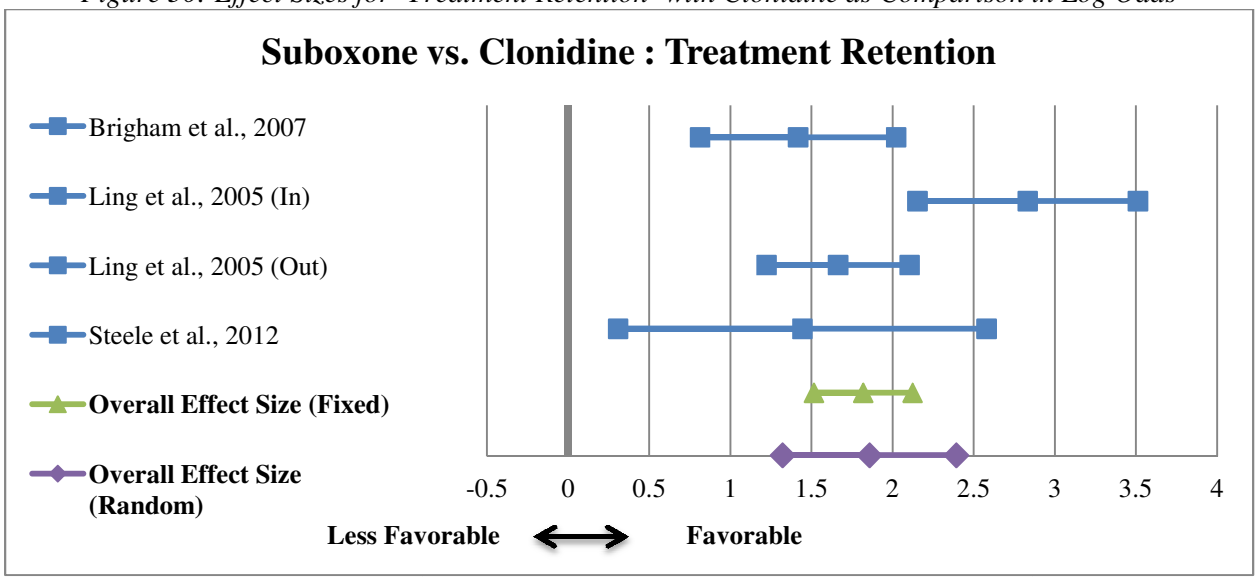
Figure 29: Effect Sizes for 'Treatment Retention' with Methadone as Comparison in Log Odds



Five studies utilized methadone as the control/comparison group when assessing Suboxone's impact on treatment retention. Overall, Suboxone's impact on treatment retention is significantly negative in comparison to those on methadone. This means that those on Suboxone are less likely to be retained in treatment than those on methadone—specifically, 50% less likely.

An additional four studies utilized clonidine as the comparison to Suboxone. These four studies measured how Suboxone impacts treatment retention as it compares to clonidine. Clonidine is used to help curb withdrawal symptoms. Figure 30 displays the analysis of effect sizes that measure the impact of Suboxone on treatment retention compared to clonidine.

Figure 30: Effect Sizes for 'Treatment Retention' with Clonidine as Comparison in Log Odds



Suboxone's impact is significantly positive when compared to clonidine. This relationship is in direct contrast with the relationship between Suboxone and treatment retention compared to methadone. Those using Suboxone are 541% more likely to be retained in treatment compared to those using clonidine. These contrasting relationships could explain why analysis that included all effect sizes was not statistically significant (see Figure 4). The competing effects of the methadone and clonidine groups may have rendered the initial relationship between Suboxone and treatment retention statistically non-significant. This brings new questions about how the different uses of methadone and clonidine shape the use or treatment outcomes of Suboxone. Differences in the use of Suboxone for initial withdrawal or for long-term maintenance may generate different impacts in treatment outcomes.

Treatment Continuation

Five effect sizes were computed for the outcome of 'Treatment Continuation'. Treatment continuation refers to the whether or not participants continued on to further treatment after the study ended. Table 33 displays the study characteristics for those that measured treatment continuation:

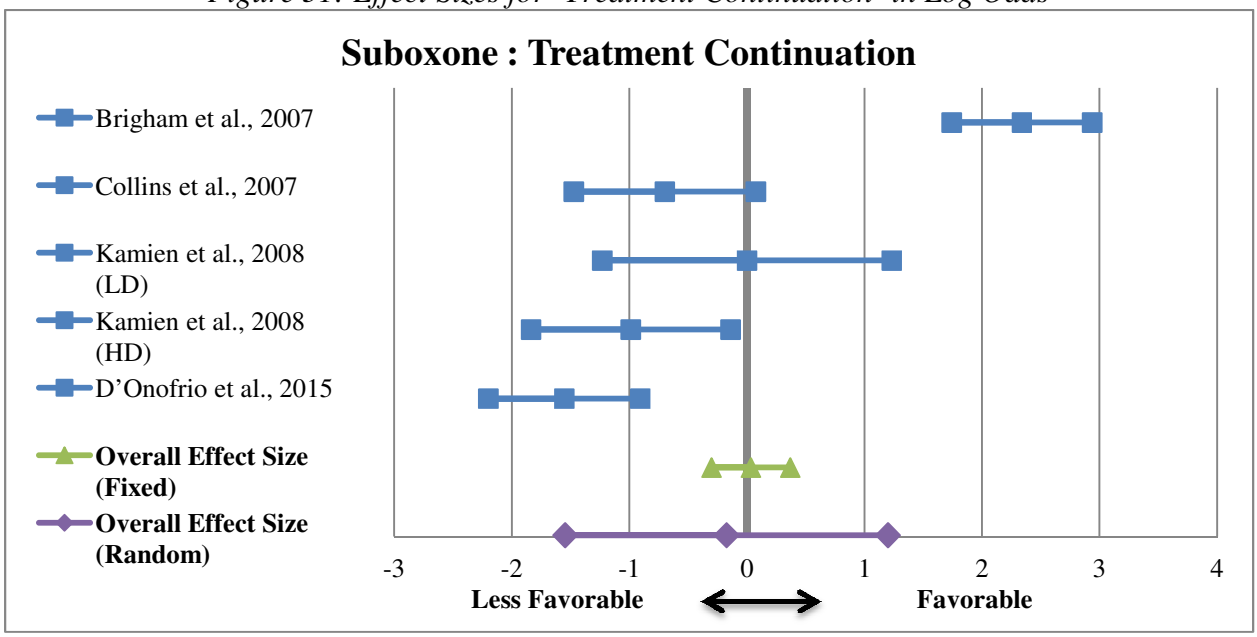
Table 33: Study Characteristics for 'Treatment Continuation' Outcome

Primary Author Last Name	Year Published	Follow-up Duration after Beginning Treatment	Total Sample Size (N)	Control Group
Brigham et al.	2007	14 Days	291	Clonidine
Collins et al.	2007	3-4 Weeks	75	Comprised Comparison Group
Kamien et al. (LD)	2008	16 Weeks	134	Methadone
Kamien et al. (HD)	2008	16 Weeks	134	Methadone
D'Onofrio et al.	2015	30 Days	218	Treatment Referral

Similar to the other treatment outcomes, the control or comparison groups for each study are different. Table 33 also shows the control groups for each study that reported 'treatment continuation'. One study utilized clonidine as the comparison group, two studies utilized methadone, one gave participants a referral to treatment, and the last comprised a comparison group that had not received treatment.

All studies were weighted equally in this analysis due to their experimental or quasi-experimental nature. Bringham et al. (2007) had a distinctly positive effect size that indicated those on Suboxone had an increased likelihood of continuing treatment. Collins et al. (2007) and the low dose sample of Kamien et al. (2008) had effect sizes that were not statistically significant. The high dose sample of Kamien et al. (2008) and D'Onofrio et al. (2015) had distinctly negative effect sizes. These studies suggest that those on Suboxone have a decreased likelihood of continuing with treatment.

Figure 31: Effect Sizes for 'Treatment Continuation' in Log Odds



The overall effect size for the relationship between Suboxone and treatment continuation is not statistically significant. This finding is consistent for the fixed effects model and the random effects model. This result, however, is greatly complicated by the differences in study design and control/comparison groups.

Adverse Events

Three effect sizes identified the impact of Suboxone on adverse events related to treatment. The term 'adverse events' refers to any health-related reaction that a patient has from withdrawal. This could include headaches, vomiting, on in extreme cases, death. The rate of those that experienced adverse events during treatment were reported in these three studies. Table 8 shows the study characteristics of the three studies measuring the impact of Suboxone on adverse events. The studies were published from 2003 to 2005, with relatively equivalent sample sizes. The follow-up duration after initial treatment initiation ranged from 14 days to 4 weeks.

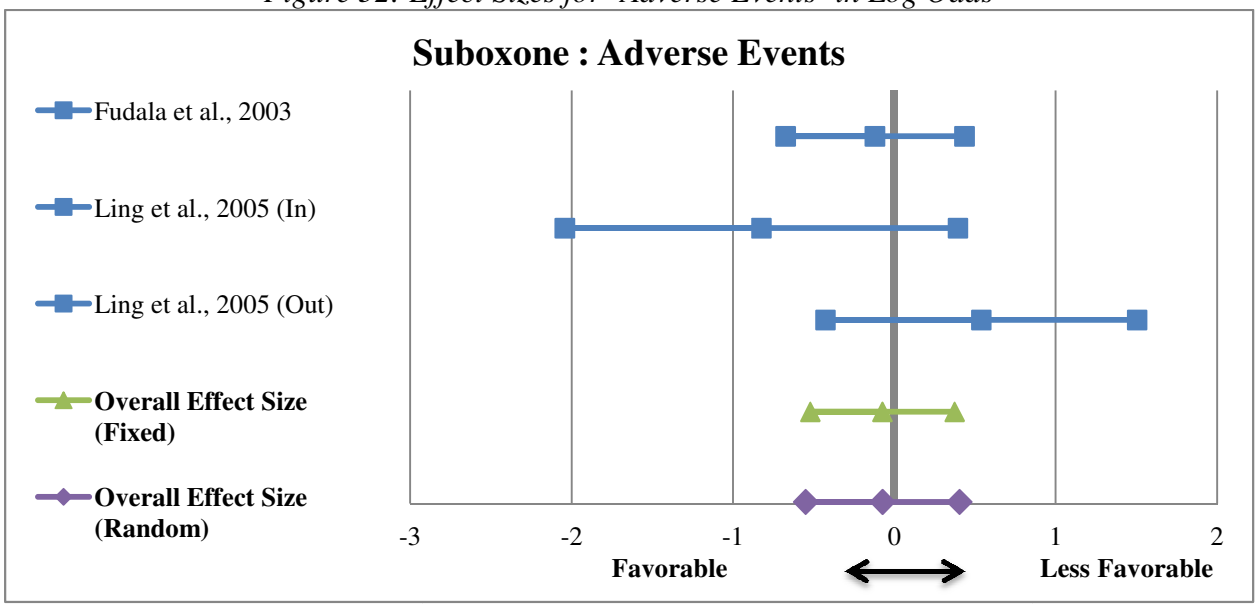
Table 35: Study Characteristics for 'Adverse Events' Outcome

Primary Author Last Name	Year Published	Follow-up Duration after Beginning Treatment	Total Sample Size (N)	Control Group
Fudala et al.	2003	4 Weeks	214	Placebo
Ling et al. (In)	2005	14 Days	113	Clonidine
Ling et al. (Out)	2005	14 Days	231	Clonidine

These three studies had different control or comparison groups. The inpatient and outpatient samples of Ling et al. (2005) utilized those taking clonidine as the comparison group to those taking Suboxone. Fudala et al. (2003) utilizes a placebo group as the comparison to those being treated with Suboxone. All studies were weighted equally when calculating for the

overall effect size. Figure 32 displays the effect sizes in log odds form. None of the effect sizes are statistically significant. It is, however, difficult to establish if a relationship exists with a minimal number of studies, where none compared to those in usual care and not taking any drug or placebo, and further research is advisable

Figure 32: Effect Sizes for 'Adverse Events' in Log Odds



This indicates that Suboxone has no statistically different impact on patients experiencing adverse events as those who took an alternative drug (clonidine) or a placebo. Additional studies with larger sample sizes and standardized usual care control groups, not similar interventions or placebos, are necessary to further explore the impact that Suboxone has on a patient experiencing adverse events. The use of placebos could have physical and psychological impact on a patient, as patients believe they are receiving the treatment.

In the above analysis, we see statistically significant findings in the impact of Suboxone on treatment retention when compared to methadone and clonidine. All other treatment outcomes did not yield statistically significant results in relation to Suboxone.

Conclusion

While the results in this analysis are limited due to differing study characteristics and control groups, the findings suggest that compared to other pharmacological substitution therapies, Suboxone can increase treatment retention compared to clonidine, and decrease treatment retention compared to methadone. This finding is consistent with the literature due to the flexibility of Suboxone's treatment regimen. The findings in health outcomes suggest that Suboxone treatment may decrease the likelihood of risky behaviors, such as needle sharing. However, additional information is needed to determine whether a true statistical relationship exists, given the small amount of studies. More studies using similar controls over longer periods of time are needed to determine the true treatment impacts that Suboxone has, both relative to other medication-assisted treatment options and to lack of MAT—particularly behavioral health programs that encourage abstinence and do not allow for MAT therapies.

Behavioral Approach: Motivational Interviewing

The use of motivational interviewing (MI) as an approach to treating substance abuse dates back to the early 1980's (Payne, 2010). Originally, MI was used for those suffering from alcoholism and has since been most impactful for those with a dependence on alcohol (Payne, 2010). The aim of MI is to enhance one's intrinsic motivation for change based on a certain target behavior, usually substance abuse (Payne, 2010). MI operates under the assumption that people want to avoid pain and increase pleasure, and are ambivalent about changing unhealthy behaviors (Payne, 2010). In this case, ambivalence refers to a person having two conflicting feelings about changing a behavior (Payne, 2010). Implementation of MI should be done under the principles of autonomy and collaboration, and be evocative.

Motivational interviews are administered via a counselor. The MI counselor's strategies should be persuasive, supportive, and increase the client's intrinsic motivation (Rubak et al., 2005). The principles that guide the counselor include expressing empathy, rolling with resistance, developing discrepancy, and supporting the client's self-efficacy (Payne, 2010). MI is traditionally delivered in two phases. The first phase includes focus on increasing an individual's motivation for change and the second phase focus on consolidating a personal commitment for change (Hettema et al., 2005). MI can be delivered as a standalone therapy, and as a prelude to, or in conjunction with, another treatment (Hettema et al., 2005). The most important aspect in MI is to be patient-driven, which allows the treatment to enhance the patient's motivation for change.

Previous Meta-Analyses

Previous meta-analyses over MI studies have shown no negative impacts of motivational interviewing on treatment outcomes (Hettema et al., 2005; Rubak et al., 2005). Hettema et al. (2005) and Rubak et al. (2005) looked at the impacts of MI on a broad range of situations, including lifestyle problems and health problems with addiction being a subsection of the analysis. Hettema et al. (2005) found that motivational interviewing has a small to medium effect on improving health outcomes. More specifically, MI's impact is amplified when it is coupled with additional treatment (Hettema et al., 2005). In other words, the positive effects that MI provides are amplified when it is given in conjunction with other therapy. Rubak et al. (2005) found similar results. Out of all the studies that focused on targeted alcohol abuse, psychiatric diagnosis, and aspects of addiction, 75% showed that MI outperformed traditional advice-giving (Rubak et al., 2005). Overall, MI has previously been shown to have positive impacts when given with other therapies or treatment in the realm of health and lifestyle problems. This analysis looks specifically at MI applied to substance abuse outcomes.

Methods

Articles for the motivational interviewing (MI) analysis were located via searches in the Oregon State University article databases, Google Scholar, and the MI section of the Washington State Institute for Public Policy. The keywords used for searches include "Motivational Interviewing" and "Motivational Interviewing for Substance Abuse". These searches resulted in the collection of 23 studies, 20 of which were quantitative studies that could potentially be used for meta-analysis.

Thirteen studies contained the necessary information to compute a total of 19 odds ratio effect sizes. The outcome variables that measured the study participant's percent of negative urine screenings and whether a study participant entered treatment after MI were the most referenced outcomes within the studies included. Four studies measured the study participants' percent of negative urine screenings and seven studies referred to the measurement for treatment entry.

Results

The effect sizes for each analysis were calculated in odds ratios with both fixed and random effects. Table 1 displays the summary of overall effect sizes for each outcome in the analyses. The outcomes measured within the MI studies included negative urine screening, treatment entry, treatment completion, participant retention, alcohol relapse, and drug relapse. Further analysis was conducted on the outcomes of negative urine screening and treatment completion due to the multiple studies they were cited in (4 and 7 studies, respectively). A statistically significant association was found for the treatment entry outcome and treatment completion outcomes. All other outcomes were found not to be statistically related to MI.

Table 36: Summary of Effect Size Results

Parameter	No. of Studies	Effect Size (OR)	90% Confidence Interval (OR)
All Studies	13	--	--
Treatment Outcomes			
Negative Urine Screening (Abstinent)	4	1.04	0.76 - 1.41
Treatment Entry	7	1.51**	1.10 – 2.07
Treatment Completion	1	2.70**	1.59 – 4.61
Participant Retention	2	1.12	0.64 – 1.98
Alcohol Relapse	1	1.06	0.58 – 1.93
Drug Relapse	1	1.86	0.79 – 4.36

Note: If the confidence interval contains 1, it is not statistically significant.

Negative Urine Screening (Abstinence)

Four studies measured the result of urine tests after participants completed motivational interviewing sessions. These studies were published from the years 2004 to 2009; the total sample size of each study ranged from 71 participants to 461 participants.

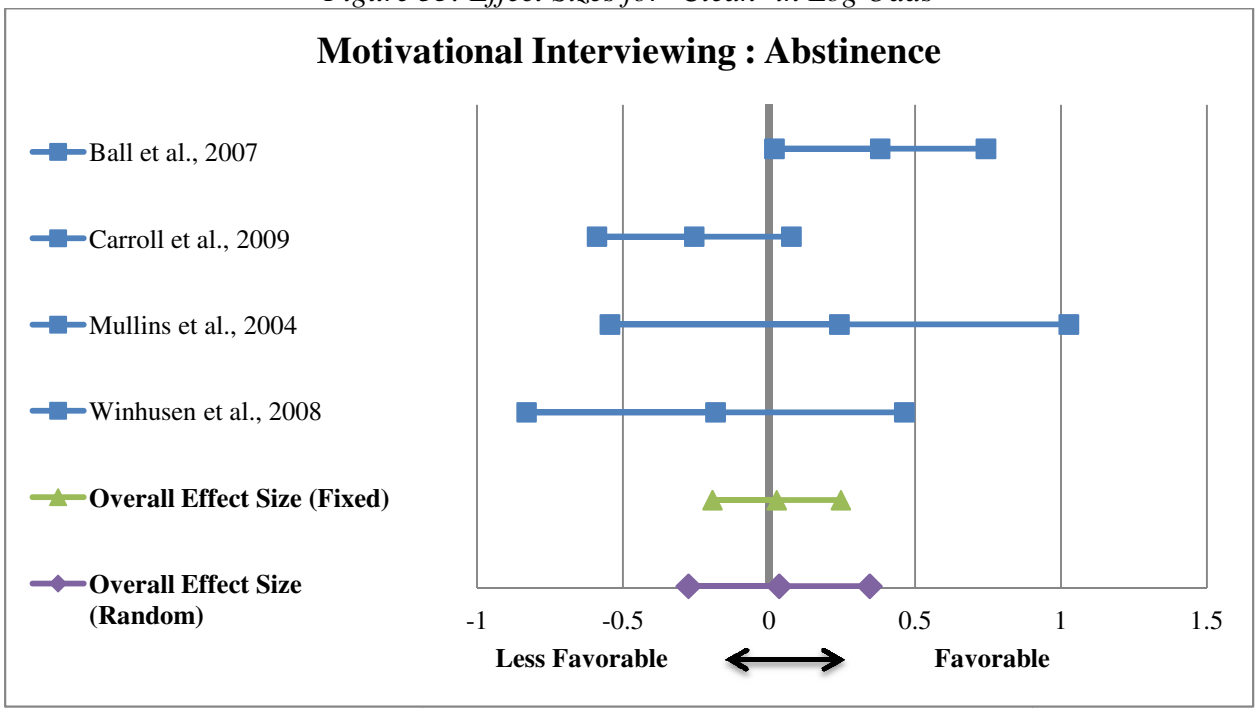
Table 37: Study Characteristics for Negative Urine Screening Outcome

Primary Author Last Name	Year Published	Follow-up Duration after Beginning Treatment	Total Sample Size (N)
Ball et al.	2007	4 months	461
Carroll et al.	2009	1-4 weeks	436
Mullins et al.	2004	After 3 MI Sessions	71
Winhusen et al.**	2008	3 months	200

** = *Women only included in study*

Results reported in Figure 33 show the overall effect that motivational interviewing has on the likelihood of a person testing negative for drugs in log odds. As a reminder, in the log odds form, results that are negative indicate a negative association between the treatment and outcome and vice versa for positive results. All studies were weighted equally in this analysis.

Figure 33: Effect Sizes for 'Clean' in Log Odds



Neither the fixed or random effect model showed any significant findings, nor did any individual study.

Treatment Entry

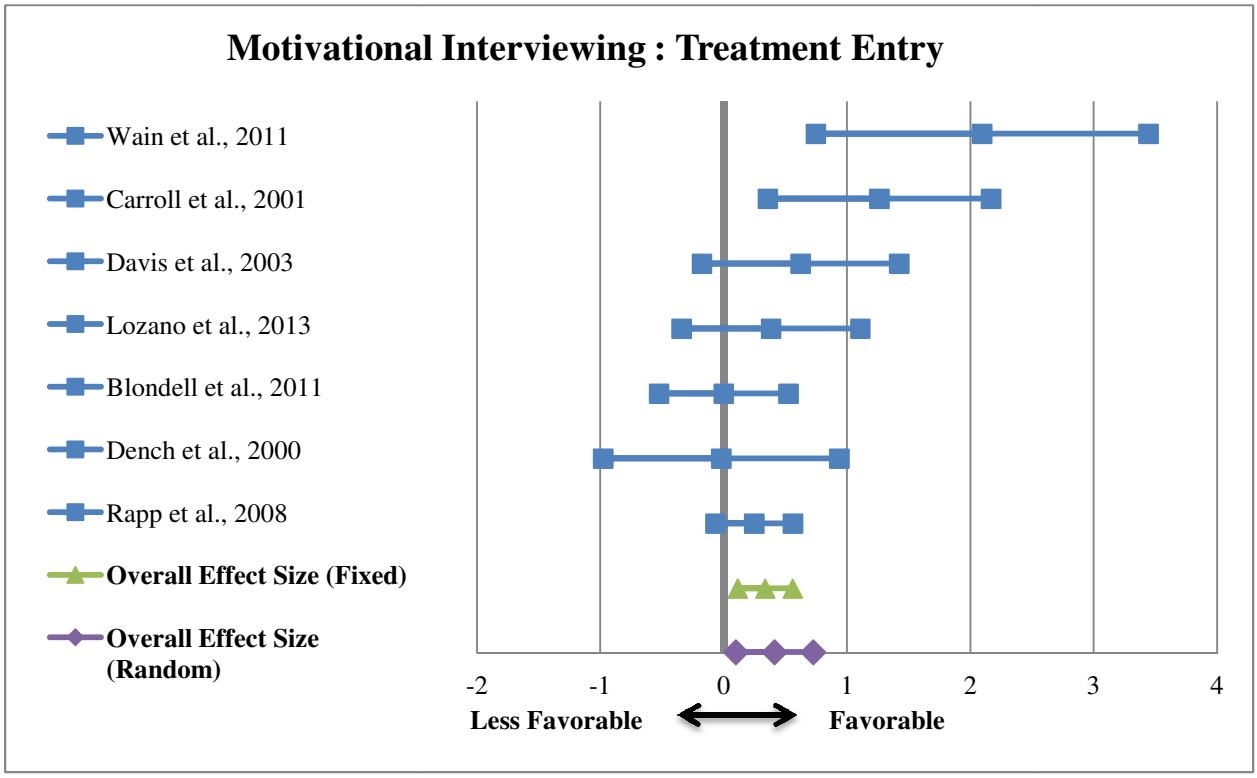
Seven studies measured if the study participants entered into substance abuse treatment at the completion of their motivational interview sessions. Table 38 describes the characteristics of each study that reported the frequency of study participants entering treatment after MI sessions. These studies were published between the years 2000 to 2013. The total sample size of each study ranged from 60 to 456. Compared to the studies that measured negative urine screening, the sample sizes of these studies were generally smaller.

Table 38: Study Characteristics with 'Treatment Entry' Outcome

Primary Author Last Name	Year Published	Total Sample Size
Wain et al.	2011	75
Carroll et al.	2001	60
Davis et al.	2003	73
Lozano et al.	2013	84
Blondell et al.	2011	92
Dench et al.	2000	51
Rapp et al.	2008	456

Studies by Wain et al. (2011) and Carroll et al. (2001) both report statistically significant results that identify a positive relationship between motivational interviewing and the likelihood of entering a treatment program. All other studies in this analysis are not statistically significant. In terms of weighting of the studies, one effect size was weighted at 0.9 or 90%; all other studies were weighted at 1[48].

Figure 34: Effect Sizes for 'Treatment Entry' in Log Odds



The total effect of motivational interviewing on the likelihood of entering a treatment program is positive and statistically significant at the 95% confidence level, despite the majority of studies indicating non-significant findings. The odds ratio effect size for the random effects

[48] Lozano et al. was weighted at 0.9 or 90% due to its quasi-experimental design without adequate controls.

model is 1.51. This indicates that MI increases the likelihood of a person entering a treatment program by 1.51 times compared to those that do not receive motivational interviewing. In terms of a percent change, a person in MI is 51% more likely to enter additional treatment compared to someone who has not participating in motivational interviewing.

Conclusion

The above analysis focuses on motivational interviewing (MI) as a treatment for substance abuse. While MI was originally developed for those with alcohol dependency, it has been widely applied to a wide spectrum of personal problems (Payne, 2010). This analysis focuses on the outcome of drug use, specifically testing negative for drug in a urine test, and entering treatment after experiencing MI. The findings of this study indicate that MI may best be applied in conjunction with additional treatment. The positive relationship between MI and treatment entry support this finding. MI acting as a complementary treatment to additional treatment was also found to have positive impacts in the existing body of research (Hettema et al., 2005). Additional research should be done analyzing the impact of MI on drug use by drug type, as well as other treatment outcomes such as relapse, and subsequent treatment completion.

Overall Findings

Table 39 illustrates the overall interpretation of the above findings. Those outcomes that are statistically significant have an associated magnitude of impact. This is found using the Cohen's D overall effect size interpretation.

Table 39: Interpretation of Overall Meta-Analysis Findings

	Abstinent	Substance Use	Duration of Abstinence	Health Outcomes
Continuing Care	Small to Moderate (+107%)		Small to Moderate (+)	
Housing Non-Abstinent	None		Small to Moderate (+)	
Housing Abstinent	Moderate to Large (+167%)		Moderate to Large (+)	
Case Management	None		None	
Peer Mentoring		Alcohol= Very Small (-23%) Drug= Small to Moderate (-32%)		
Methadone		None		
Suboxone	None			None
Motivational Interviewing	None			
	Healthcare Utilization	**Criminal Justice Outcomes**	**Employment**	**Treatment Engagement**
Continuing Care				None
Housing Non-Abstinent	Large (-)	None		
Housing Abstinent		Small to Moderate (-56%)	Moderate to Large (+192%)	
Case Management	Moderate to Large (-)	None		Small to Moderate (57%)
Peer Mentoring				None
Methadone		Large (-82%)	None	
Suboxone				None
Motivational Interviewing				Small to Moderate (+51%)

The above meta-analytic results allowed several conclusions to be made. First, abstinent contingent housing outperformed other treatment options (e.g. had the largest magnitudes) in the areas of abstinence, duration of abstinence, and employment, when compared to control groups. Second, in the area of healthcare utilization, non-abstinent contingent housing outperformed other tested programs. Third, methadone had the biggest impact on criminal justice outcomes. Fourth, most wraparounds and medication-assisted treatments did not impact treatment engagement except for case management; which was shown to have a small to moderate positive impact. Last, when analyzed by treatment type, treatment options that are classified as "wraparounds" appeared to have large impacts on most treatment outcomes; while medication-assisted therapies (e.g. methadone and suboxone) appeared to have less impactful results.

While meta-analysis is an excellent method for standardizing and synthesizing literature, there are several caveats worth noting. First, the method excludes qualitative data, which can often be a rich source of information. This exclusion of data inevitably creates a systematic bias in research findings. Second, several studies were excluded because they didn't report adequate information for an effect size to be created. Likewise, this could potentially create a systematic bias, whereby only a certain type of study is included in analysis. Third, studies were weighted by researchers based on study quality. This weighting scheme, which was partially derived from the WSIPP meta-analytic study, is purely arbitrary and could ultimately impact overall research findings.

Aside from meta-analytic caveats, another important detail of this study relies on treatments and outcomes studied. Accordingly, it is worth noting in this technical document that not every outcome for every treatment was studied. This was either due to a lack of literature (e.g. not much literature examining the impact of a treatment on an outcome) or because it was nonsensical to study the impact of an outcome on a given treatment (e.g. it doesn't make sense to examine the impact of a treatment on an outcome).

What is more, all of the analyzed research is population and time-specific. For that reason, individual effect sizes can only "speak for" for the studied population during the studied time. However, this meta-analysis attempts to synthesize these effect sizes into an overall effect size, which is used to generalize study results. Thus, in order to safely generalize these potentially heterogeneous findings with an overall effect size (e.g. to say that: across all of the surveyed literature, which may have different sampled populations, non-abstinent contingent housing has a large positive effect on healthcare utilization), this technical document utilized a more *conservative* random effects model in its analysis— a model for calculating an overall effect size that assumes that effect size variability is due to sampling error *plus* true differences between studies. Besides utilizing the random effects model, this technical document is also careful to not insinuate that meta-analytic results will yield equivalent outcomes in Multnomah County or Oregon. Thus, this document acknowledges that the County, and Oregon as a whole, may have unique characteristics that will dictate how various programs studied drive outcomes. Instead, this analysis presents conservative meta-analytic results alongside Oregon data in an attempt to give readers context.

Outcomes in the Context of Multnomah County, Oregon

Substance abuse costs approximately $712 billion annually and spans budgets related to health care, crime, and lost work productivity across the United States[49]. The previous meta-analysis, while helpful for synthesizing a diverse body of literature, becomes far more practical for policymakers if it can be examined alongside Multnomah County and Oregon-level data.

Criminal Justice Outcomes

Many individuals who suffer from addiction and substance abuse find themselves involved with the criminal justice system. It is estimated that anywhere from 60 to 85% of those in local, state, or federal correctional facilities abuse substances as any given time[50]. To put this in the context of Oregon, the Department of Correction reported that approximately 10,336 inmates, or 71.2% of all inmates, were classified as having "Dependence/Addiction" or "Some Substance Use" in January 2015[51]. Keeping these inmates in custody costs the state approximately $87.08 per day. Specifically in Multnomah County, there were approximately 1,304 drug and/or alcohol-related charges given to those arrested in 2012 per 100,000 residents (3,473 arrests per 100,000 residents total). As a bare minimum estimation, about 15% of all arrests are related to drugs and/or alcohol, and may be as high as 38% of arrests[52].

Of the interventions studied in this project, abstinent contingent housing and methadone were found to have significant impacts on decreasing criminal justice outcomes. Specifically, the odds of being arrested while in abstinent housing are 56% less than it is for someone not receiving housing, while methadone treatment is associated with an 82% decrease in the likelihood of arrest. This has the potential to decrease the number of people arrested, in turn saving the state and county money in processing and holding inmates.

Healthcare Utilization Outcomes

A significant amount of research is devoted to analyzing the level in which several of the aforementioned treatment options decrease the number of costly emergency department visits among those with substance abuse problems, including those publicly funded (Sadowski, 2009; Srebnik, 2013). For that reason, emergency department visits are another core outcome of focus in this technical document. Research shows that individuals that are unemployed, homeless, and disabled by chronic illness, mental illness, or battling chemical dependency, often cycle between hospitals, emergency rooms, and other institutional health settings. This cycle often leads to very high usage rates of expensive, publicly funded, health care services (Srebnik, 2013); entire areas of economic study focus on overuse of healthcare, to the point at which use becomes ineffective and even fails to yield any benefits to the user (Gruber, 2012).

Ultimately, substance abuse treatment programs can help mitigate this overutilization of ineffective healthcare services by addressing the source of high health care usage rates—for example, homelessness coupled with chemical dependency and other issues. The use of wraparounds directly addresses many of the social factors that contribute, while direct treatment, if successful, may help reduce or eliminate many medical conditions. To put this policy area into

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[49] From http://www.drugabuse.gov/related-topics/trends-statistics

[50] Hiller, M. L., Knight, K., & Simpson, D. D. (1999). Prison-based substance abuse treatment, residential aftercare and recidivism. *Addiction (Abingdon, England)*, *94*(6), 833–842.

[51] http://www.oregon.gov/doc/GECO/docs/pdf/IB-53-Quick%20Facts.pdf

[52] http://navigator.state.or.us/cjc/

local context, from September 2012 to January 2015, there were 7,641 reported emergency department visits in Multnomah County by 3,270 Medicaid/Medicare-insured individuals who were identified as having an alcohol or drug dependence or abuse issue. This equates to 263.5 visits per month. Using additional Medicaid emergency department data, this results in slightly over three quarters of a million dollars ($750,237.20) a month in public healthcare costs, on average. This does not represent the privately insured, uninsured (such as many homeless patients), or those for whom an issue was not identified or recorded, and is thus likely an underrepresentation of the true human and financial costs.

Of the studied interventions, case management and non-abstinent contingent housing both had significant impact on decreasing the number of ER visits, compared to others in treatment who did not receive these services. Use of these services could greatly impact emergency department over-utilization in Multnomah County. However, further research on wraparound service options that were not meta-analyzed for this outcome—like abstinent contingent housing or peer mentoring—is also recommending before making any local conclusions.

Employment Outcomes

Employment is another core outcome of focus in this report. Addiction can compromise an individual's ability to maintain steady work. While not a "silver bullet," where lacking, employment is an important step toward self-sufficiency for individuals battling substance abuse issues, a provider of dignity, and a source of daily structure. Increased employment can have a direct impact on public finance. For instance, unemployed or underemployed individuals may utilize publicly funded services, such as Medicaid/CHIP, food stamps, TANF, and Section-8 housing. Yet, legitimate employment opportunities can provide individuals with credible work experience and a legal income and reduce impact on these funding streams, as well as contribute to a healthy economy.

In terms of public assistance, Medicaid is the most critical publicly funded service to put into an Oregon context. According to a Medicaid.gov report[53], Oregon enrollment figures in Medicaid and CHIP now exceed 1 million users—which equates to nearly 25% of the state's population.

Two other critical areas of public services are food and cash assistance programs. The Oregon Office of Business Intelligence reports that the Supplemental Nutrition Assistance Program (SNAP) had 757,000 persons draw assistance[54]. Likewise, Temporary Assistance to Needy Families (TANF) levels, according to caseload data from the Office of Family Assistance, averaged 56,000 participants per month for the 2014 fiscal year[55]. Housing assistance is also a critical public assistance program in Oregon. Data from the US Department of Housing and Urban Development estimates that there are 6,640 total household members and 2,812 households[56] receiving public housing or Section-8 Housing in Oregon.

Our results showed that abstinent contingent housing had moderate to large impacts on increasing the odds of employment—suggesting that there is reason to presume that this program can potentially have positive impacts on employment within the County. Conversely, non-

[53] http://www.medicaid.gov/Medicaid-CHIP-Program-Information/By-State/oregon.html
[54]http://www.oregon.gov/dhs/assistance/Branch%20District%20Data/Supplemental%20Nutrition%20Assistance%20Program%20Flash%20Figures.pdf
[55] https://www.acf.hhs.gov/sites/default/files/ofa/2014_recipient_tan.pdf
[56] https://hudapps.hud.gov/public/picj2ee/Mtcsrcr?category=rcr_housesize&download=false&count=0

abstinent contingent housing and methadone treatment programs were not found to impact the odds of employment.[57] Again, this lack of an impact could be due to the shortcomings of meta-analysis, which do not incorporate qualitative methods into the results. What is more, this impact can also be due to the fact that these employment outcomes were binary. It is likely that those battling substance abuse addictions may not be able to work enough to be classified as "employed." Instead, another employment indicator, like number of hours worked a month or income from employment, should also be explored. Ultimately, in order to extrapolate and generalize findings to the County with much certainty, further local research is needed.

Big Picture Implications

The Substance Abuse and Mental Health Service Administration reports that Oregon is similar to the national average of those using illicit drugs annually, with approximately 3.7% of the population, or 120,000 people, using illicit drugs in a given year. However, juvenile/youth illicit drug use is higher than the national average, with 12.7% of youth, or 37,000 adolescents, using in a given year. Additionally, rates of alcohol use or abuse are similar to those nationally, with 235,000 people reporting abuse of dependence in 2013[58]. Approximately 21,898 individuals were receiving treatment on any given day in 2013 out of the 307,000 struggling with alcohol or illicit drug dependence. Of those receiving treatment, "in a single-day count in 2013, 33.0% were in treatment for drug use only, 25.1% were in treatment for alcohol use only, and 42.0% were in treatment for both drug and alcohol use".[59] Since 2009, the numbers of those enrolled in treatment have decreased, and a recent *Oregonian* series (December 2014) strongly critiqued both the small number of Oregonians able to access treatment and the lack of data analysis to support treatment interventions being utilized. Our findings indicate that continuing care, non-abstinent contingent housing, abstinent contingent housing, and peer mentoring have the potential to decrease the likelihood of drug use, or increase the likelihood of abstinence or extent abstinent over time.

With 8.7% of the Oregon population struggling with substance abuse, continued evidence-based action is necessary. Focus on treating addictions can promote the continued health and well-being of our citizens, as well as potentially yield public benefits, both social and financial, in terms of reducing arrest rates, emergency room use, unemployment, and social service dependency. Each of the above treatments has various strengths and weakness that, when used together, show great promise in combating drug and alcohol addiction. In the area where one treatment may be lacking, another can help to fill the void. Through taking a multi-dimensional approach to substance abuse, greater success can be achieved for our citizens and our communities. While no one treatment will end all addiction, a multidimensional and holistic approach, using a variety of treatments and resources can work to end addiction and dependency.

[57] Additional treatments (case management, peer mentoring, continuing care, and motivational interviewing were not analyzed for this outcome).

[58] http://www.samhsa.gov/data/sites/default/files/NSDUHsaeSpecificStates2013/NSDUHsaeOregon2013.pdf

[59] http://www.samhsa.gov/data/sites/default/files/State_BHBarometers_2014_2/BHBarometer-OR.pdf

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