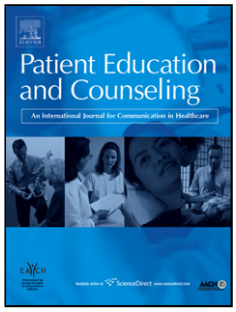

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Motivational interviewing in medical care settings: A systematic review and meta-analysis of randomized controlled trials

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Abstract

Objective

Motivational Interviewing (MI) is a method for encouraging people to make behavioral changes to improve health outcomes. We used systematic review and meta-analysis to investigate MI's efficacy in medical care settings.

Methods

Database searches located randomized clinical trials that compared MI to comparison conditions and isolated the unique effect of MI within medical care settings.

Results

Forty-eight studies (9,618 participants) were included. The overall effect showed a statistically significant, modest advantage for MI: Odd Ratio = 1.55 (CI: 1.40 to 1.71), $z = 8.67$, $p < .001$. MI showed particular promise in areas such as HIV viral load, dental outcomes, death rate, body weight, alcohol and tobacco use, sedentary behavior, self-monitoring, confidence in change, and approach to treatment. MI was not particularly effective with eating disorder or self-care behaviors or some medical outcomes such as heart rate. MI was robust across moderators such as delivery location and patient characteristics, and appears efficacious when delivered in brief consultations.

Conclusion & Practice Implications

The emerging evidence for MI in medical care settings suggests it provides a moderate advantage over comparison interventions and could be used for a wide range of behavioral issues in health care.

1. Introduction

Unhealthy eating, smoking, excessive drinking, and lack of exercise are among the most important modifiable causes of health care problems in the developed world (1, 2). As medical care increasingly focuses on managing long-term conditions, clinicians have a growing need to motivate patients to make lifestyle changes that modify risk factors and optimize adherence to medical advice (3).

One counseling approach for promoting behavior change in medical care is MI, defined as "a person-centered counseling style for addressing the common problem of ambivalence about change." (4) MI arose from efforts to start difficult conversations with patients about risky alcohol intake (5). The inclination to confront or persuade patients was replaced by evoking clients' own reasons to change, which minimized resistance (6). Later innovations focused on people's natural use of language about change and how listening skills might evoke such language (7). MI is both flexible and robust, producing desirable outcomes across many problem areas in different formats (4). That is, MI can focus on a variety of problem behaviors—typically one at a time—and can be delivered in a single session or through multiple sessions, including as a prelude to other treatments (e.g., inpatient care), integrated with other treatments (e.g., cognitive behavior therapy), or as a stand-alone intervention.

The relevance of MI to health care settings emerged in studies on providing feedback of medical test results (8, 9). Whereas MI is patient-centered, it is also directional in its focus on change targets, including health behaviors. Refinements to suit health care consultation therefore

emerged along with outcome studies (10-12). MI has now been learned and implemented by practitioners of diverse professions, including medical providers (13-15), and appears durable up to 1-year post treatment (16).

Reviews of MI cover mostly mental health outcomes; when medical outcomes have been targeted, outcomes generally result from studies outside of primary care settings (15-24). Taken together, these reviews yield odds ratios for MI treatments in the 1.5 range (a 50% benefit) versus patients who do not receive MI. A systematic review of MI delivered in physical health care settings has been conducted (25), though no known meta-analysis has been conducted on MI within medical settings. Our study seeks to fill this gap, as a meta-analysis uniquely provides a broad perspective and bird's eye view of the value of a specific treatment, which can then be used to focus future individual-level research.

Our study investigated whether MI holds true potential as a treatment option alongside or within the delivery of routine medical care. This review is the first to focus explicitly on the effects of MI delivered in general medical care settings across a range of problem behaviors. Accordingly, the aims of this study are threefold: (1) clarify the general efficacy of MI in medical care settings; (2) ascertain whether MI effects in medical care are moderated by medical problem type, delivery (e.g., treatment setting, dose of MI, provider MI training), patient characteristics (e.g., ethnicity, gender, or age), or study design characteristics (e.g., methodological rigor); and (3) provide guidance for future research of MI in medical care settings.

2. Method

2.1 Study eligibility criteria

We followed PRISMA guidelines in conducting this study. Studies were included if they: used MI or motivational enhancement therapy (MET; MI plus feedback); employed a randomized trial that isolated MI's unique effect by comparing it to another group of patients who did not receive MI; and was conducted in a medical care setting such as a hospital, physician clinic, emergency department, medically-guided weight loss or diabetes center, dentist office, or physical therapy office. A study was excluded if: patients were consulting specifically for help with addictions or mental or behavioral health, as opposed to consulting for general medical conditions; it took place in an HIV specialty clinic (not a general medical center providing HIV treatment); MI was delivered only through a computer-based program without human contact; it was not published in English or in a peer-reviewed source.

2.2. Information sources

Research reports were identified from the following databases: PubMed, MedLine, CINAHL, Health Source: Nursing/Academic Edition, PsycARTICLES, PsycINFO, Scopus, Social Work Abstracts, Web of Knowledge; reports were also identified from an MI bibliography created by the Motivational Interviewing Network of Trainers (MINT; 26). The search spanned from 1983 to August 2011.

2.3. Search Strategy

Search terms included: 'motivational interview*' OR 'motivational enhancement therapy.' See Figure 3.

2.4. Data collection

Once the final group of studies was identified, all studies were independently coded by two authors. The average inter-rater reliability (kappa) was *M* = 0.84 (*SD* = 0.08) for the categorical moderators and *M* = 0.88 (*SD* = 0.09) for the continuous moderators, suggesting reliable coding.

2.5 Coding articles

The code sheet was designed to identify factors that may influence the efficacy of MI in medical care settings. These potential moderators were divided into three groups: (a) delivery of MI, (b) patient characteristics, and (c) study design.

2.5.1. Delivery of MI

2.5.1.1 Study location. MI was used in a variety of medical locations (see Table 2).

2.5.1.2. Patient exposure to MI. Table 1 shows descriptive characteristics of included studies. The average time patients received MI was 106 minutes, longer than the 30 minute interventions for comparison groups. The mean number of sessions dedicated to delivering MI in a face-to-face interaction was 2.6 (or 3.0 sessions of phone MI).

2.5.1.2. Amount of provider MI training. The amount of MI training providers received (see Table 1). Providers spent an average of 18 hours learning MI, though there was a wide range (4 to 40).

2.5.1.3. Type of MI. Feedback was provided from standardized assessment instruments in MI style (i.e., MET) in 21 studies, whereas 30 studies delivered basic MI without problem feedback.

2.5.1.4. Provider. Who delivered MI (Table 4): mental health professionals (13 studies), nurses (6 studies), dieticians (3), physicians (2), or mixed provider types.

2.5.1.5 Use of supervision toward fidelity. Whether studies supervised MI practice (36 studies) and, where available, how accurately the providers delivered MI (only 8 studies assessed MI treatment fidelity).

2.5.2. Patient characteristics

We also coded patient characteristic variables (Table 6): age, sex, ethnicity, and the stage of disease (i.e., primary, secondary, or tertiary prevention).

2.5.3. Study Design

2.5.3.1. Comparison group. Three broad types of comparison groups were employed: (1) 7 studies used a traditional waitlist group, (2) 16 studies used information only groups, such as providing a brochure about obesity management or safe sex practices, and (3) 28 studies employed "treatment-as-usual" conditions, which were heterogeneous and ranged from routine medical advice to cognitive behavioral treatments.

2.5.3.2. Measurement type. We coded three measurement types: (1) 24 studies used biophysical indicators such as glycosylated haemoglobin tests for blood glucose control, Human Immunodeficiency Virus (HIV) viral load, Body Mass Index (BMI) for weight, or carbon monoxide or saliva cotinine verification of tobacco abstinence; (2) 12 studies used clinical records such as attending appointments or completing monitoring journals on diet; and/or (3) 44 studies used self-report measures on topics such as quality of life (e.g., depression, confidence) or reports on behavior beliefs (e.g., safe sex behaviors).

2.5.3.3. Study rigor. Study rigor was assessed on an 18-point scale using criteria from existing assessment instruments and approaches such as the Cochrane system (27-29**;** code sheet available upon request). Each study was rated by two of the authors (BL, TM) on criteria such as number of participants, attrition, quality control, whether fidelity of MI delivery was assessed, objectivity of measurements, and reporting of follow-up data. Total rigor ratings ranged from 7 to 17 in these studies (Table 1) and inter-rater reliability was high (r = 0.85).

2.6. Outcomes

In addition to the above moderators, the various medical outcomes assessed by individual studies were also treated as moderators. These outcomes, presented in Table 3, were grouped into the following 7 categories:

- Prognostic markers
- Disease endpoints
- Risk reduction behaviors
- Physical functioning and quality of life
- Substance abuse
- Patient adherence to medical advice and treatment protocols
- Patient approach to change

2.7. Effect size calculation and analytic strategy

The Odds Ratio was used as the primary effect size in this review. An OR of 1.0 suggests MI was equal to the comparison group, whereas an OR of 1.5 suggests that those in the MI group were one and a half times more likely to improve than those in the comparison group.

A useful way to express ORs in meta-analyses is the Binomial Effect Size Display (BESD),which illustrates the practical importance of an effect by displaying it as a two-by-two contingency table [Group (MI, comparison) x Improvement (yes, no)] (30). This allows for calculation of percent improvement in each group. When MI outperformed the comparison group, the percent improved is above the 50% mark for MI and below 50% for the comparison group. The difference in percentages reflects the extent to which MI increases patient improvement relative to controls (30).

Comprehensive Meta-Analysis software (31) was used to calculate ORs and run moderator analyses. All analyses were calculated at the 95% Confidence Interval (CI) level. A random effects model was used because our search strategy may not have captured all relevant studies (29). Regression analyses for continuously distributed moderators utilized the “unrestricted maximum likelihood” method, which is similar to the random effects model (32).

In meta-analysis, there are two possible ways to statistically combine outcomes. The first is to select only one effect size (“n”) per study (“k”); the second is to use all the available effect sizes (“n”) even if several of them are derived from the same study (“k”). Whereas multiple effect sizes derived from a single study are not technically independent, experts argue that running analyses at the effect size level is unlikely to cause biased estimates (33). Moreover, including multiple effect sizes from a particular study often serves to produce a more conservative estimate (34) as well as to optimize statistical power (35, 36). Thus, we reported summary statistics at the

effect size level when this allowed all data to be captured. For example, because some studies reported on more than one outcome (e.g., alcohol consumption and safe sex practices), analysis of MI's impact—both overall and by medical outcome category—was calculated at the effect size level. Conversely, moderator analyses were run at the study level because a given moderator was constant for all outcomes in that study. For example, the location in which MI was delivered in a particular study was the same regardless of outcomes assessed. In our study, "n" is used when reporting effect-size level statistics and "k" is used when reporting study-level statistics. (Note: Overall patterns did not differ when analyses were run at the study or effect size level).

3. Results

Our selection criteria yielded 48 unique studies with 51 comparisons and 332 effect sizes. This occurred because some studies had more than one comparison group and many studies reported multiple effect sizes by measuring multiple outcomes **or** the same outcome with multiple instruments and/or **by** repeatedly assessing outcomes across time. Across all studies, there were 9,618 participants. To control for outlier effects (29), approximately 8% of the highest and lowest effect sizes were winsorized, leaving a total of 312 effect sizes for final analyses.

Our results are organized around the three goals of meta-analyses: central tendency, variability, and prediction (37).

3.1. *Central tendency*

What was the overall magnitude of effect of motivational interviewing interventions?

The omnibus effect size (OR) across the 51 comparisons and 312 effect sizes was statistically significant and positive for MI: OR = 1.55 (95% CI: 1.40 – 1.71), $z = 8.67$, $p < .001$. At the study

level, 63% of comparisons were positive and statistically significant at the $p < .05$ level, 10% had an OR below 1.0, although none was statistically significant. The remaining 27% of the studies showed a nonsignificant advantage for MI. The omnibus OR reveals that, on average, patients receiving MI were 1.55 times more likely to improve than those in the comparison groups. The BESD suggests that 56% of participants improved by having received MI whereas only 44% improved under the comparison conditions. The OR at the 25th percentile was 1.00, 1.46 at the 50th percentile, and 2.36 at the 75th percentile. Table 2 provides an overview of individual studies. Figure 1 provides a Forrest Plot of effect sizes at the study level.

3.2. Variability

Was the overall effect size stable?

The omnibus effect size showed significant heterogeneity, Qw (311) = 521.68, $p < .001$; I-squared = 90.42, suggesting a need for moderator analyses (below).

3.3. Prediction

Because we sought to examine the pragmatic question of MI's general effectiveness in medical care settings, the first moderator we explored was targeted medical outcomes, as shown in Table 3. ORs varied significantly across these specific outcome categories, Qb (28) = 130.02, $p < .001$.

3.3.1. How did MI effects vary by targeted outcomes?

MI showed significant positive impact on three of five prognostic markers: blood pressure, cholesterol, and HIV viral load (but neither blood glucose nor heart rate). Two research groups studied the impact of MI on HIV viral load, which showed the strongest effect of all prognostic

markers. In terms of disease endpoints, MI lowered both dental caries and death compared with controls.

MI also had positive and statistically significant effects on lowering the amount of alcohol consumed, decreasing dangerous alcohol consumption, increasing tobacco abstinence, and decreasing the amount of marijuana smoked. MI was applied to substance abuse within a medical care setting using several different time formats and provider types (see Table 2). These studies ranged from physicians providing 20 minutes of MI with follow-up phone calls in an emergency department setting with substance abusers (38) or a 15-minute MI intervention focused on alcohol and drug use following patient screening in a primary care clinic (39), to a psychologist meeting with patients for a series of meetings lasting about 150 minutes in a physician's clinic (40) or a nurse delivering three 15-minute MI sessions to patients identified as having hazardous drinking patterns (frequent use, binge drinking) in Thailand (41).

In most other targeted medical areas, MI produced mixed results. Regarding risk reduction behaviors, MI showed mainly non-significant results despite positive trends. MI had no significant effect in 20-minute sessions for injured adolescents who presented at an emergency department where the focus was to increase wearing seatbelts or bicycle helmets and decrease riding with a drunk driver (47). MI also did not have any significant impact on healthy eating, safe sex practices (e.g., condom use), fewer sexual partners, and reporting positive STD status to potential sex partners (42-44). MI showed a possible disadvantage in one study for eating disorder behaviors such as vomiting and laxative usage compared to CBT (45). However, MI did yield a statistically significant impact on body weight in 10 studies as measured by BMI, weight, and waist circumference.

The results related to MI's impact on physical functioning and other quality of life indicators were mixed. MI patients did not achieve statistically significant greater functional independence following a stroke relative to those in a comparison condition (47, 48). However, patients in an MI condition enjoyed statistically significantly better outcomes on physical strength and disability-related behaviors targeted by physical therapy compared to those who participated in physical therapy without MI (46). Six research groups assessed other quality of life indicators (46-51) including worry, anxiety, depression, pain, and adjustment to diseases such as diabetes, stroke, and chronic heart failure, which together showed a statistically significant advantage for MI.

In terms of adherence to medical advice, MI had a statistically significant effect on patients' self-monitoring, which included actions such as monitoring blood-sugar levels and food intake, as well as on encouraging non-sedentary behavior, such as increasing exercise, strength training, and reducing television watching. MI produced a statistically increase in patients' sense of confidence about approaching change when dealing with conditions such as diabetes, cardiovascular problems, or smoking. In addition, those in MI conditions were significantly more likely to keep appointments, participate in treatment, and report increased intention to change. However, MI did not yield significant results when applied to recommendations regarding breast feeding (52) and did not outperform control groups when applied to self-care activities for managing epilepsy (53) or following heart failure (54). MI also had mixed impact on medication adherence, an important component of behavioral medicine: MI promoted compliance to ART medication among HIV patients (55) and had a strong impact on lowering the overuse of prescriptions for pain and discomfort, although this benefit disappeared at the 1-year follow-up (55). Conversely, MI did not improve medication adherence among people with epilepsy (53).

3.3.2. What other variables moderated MI outcomes?

As shown in Table 4, MI did not have significantly different outcomes across eight medical settings, Qb = 5.46, (7), $p = 0.60$, or five typical provider types, Qb = 8.92, (4), $p = 0.06$. All sites showed significantly positive outcomes for MI, with the exception of settings that also provided treatment for HIV. Although each provider type produced positive outcomes, only mental health providers and mixed teams reached statistical significance. Whereas MI was delivered more often by non-physicians, physicians also appeared effective in the two studies wherein they delivered MI. No consistent advantage was found from offering MET (OR = 1.79, k = 21; CI: 1.34 – 2.40) compared to typical MI (OR = 1.21, k = 30; CI: 1.21 – 1.6), Qb (1) = 1.72, $p = 0.19$. Finally, reported supervision of MI delivery (OR = 1.64, k = 36; CI: 1.34 – 2.06) did not produce an advantage when compared to studies that did not report supervision (OR = 1.39, k = 15; CI: 1.12 – 1.72), Qb (1) = 1.26, $p = 0.26$. Interestingly, studies assessing MI fidelity showed significantly lower impact (OR = 1.12, k = 8, CI: 0.96 – 1.2) relative to those that did not assess fidelity (OR = 1.72, k = 43; CI: 1.44 – 2.07, Qb (1) = 13.70, $p < .001$). All studies assessing fidelity indicated high adherence to the MI model.

In terms of study design, comparison group did not moderate MI outcomes but measurement type and follow-up period did. MI showed the strongest effects when compared to waitlist no-treatment groups (OR = 1.91, k = 7; CI: 1.38 – 2.64); however, this value did not statistically differ from information-only groups (OR = 1.54, k = 16; CI: 1.29 – 1.83) or treatment-as-usual groups (OR = 1.49, k = 28; CI: 1.34 – 1.71), overall Qb (2) = 1.81, $p = 0.41$. The measurement method did moderate MI outcomes: Effect sizes for biophysical indicators were lowest (OR = 1.18, k = 24; n = 78; CI: 1.09 – 1.28), followed by records (OR = 1.48, k = 12, n = 30; CI: 1.24 – 1.78), with self-report indicators yielding the highest effects (OR = 1.69, k = 44, n = 204; CI:

1.55 – 1.84, Qb (2) = 33.66, $p < .001$). Further analyses revealed biophysical measures were significantly lower than both self-report indicators (Qb = 33.28, $p < .001$) and records (Qb = 4.88, $p < .05$), which did not differ significantly from each other (Qb = 1.56, $p = 0.27$.

Results related to durability were mixed (see Table 5), with significant variance between different time points, Qb (3) = 29.35, $p < .001$. Within a 1-year time frame, MI's impact showed ORs in the 1.30 to 1.70 range. Of the 5 studies that examined MI beyond 13 months, the OR dropped to 1.14 which was significantly lower than effects 7-12 months after treatment (Qb = 4.53, $p < .05$) and 5 weeks to 6 months after treatment (Qb = 28.54, $p < .001$). However, differences between MI's effects immediately following treatment and beyond 13 months were not statistically significant (Qb = 3.25, $p > .06$), and MI yielded significant positive effects beyond 13 months.

In terms of patient characteristics, stage of disease did not significantly moderate MI effects: primary-prevention (OR = 1.38, k = 4; CI: 1.14 – 1.68), secondary-prevention (OR = 1.32, k = 7; CI: 1.05 – 1.68) or tertiary-prevention (OR = 1.54; k = 36; CI: 1.42 – 1.76), Qb (2) = 1.83, $p = 0.43$.

Continuous moderators bearing on outcomes were also examined via meta-regression (see Table 6). Provider training time, patient age, sex, and ethnicity, and study rigor were not significantly associated with MI outcome. Whereas the number of MI sessions provided in person or by phone was unrelated to outcome, the total amount of time patients received in MI interventions approached significance ($p = .06$) such that longer total treatment resulted in stronger MI effects.

3.3.3. Was there evidence of publication bias?

No. In primary research, significant results are more likely to be published than nonsignificant results, which can positively skew systematic reviews (56). We assessed the likelihood of publication bias using three accepted methods. Rosenthal's Fail-safe *N* test indicated that 5604 additional studies with null results *not* included in the meta-analysis would be needed to make the overall MI effect non-significant. Orwin's Fail-safe *N*, a more conservative test (31), indicated that 185 studies with null results would render the omnibus effect non-significant. Both numbers are large considering the number of included studies in this review (k = 48). Figure 2 shows a Funnel Plot of the Standard Error, which is symmetrical. These three pieces of evidence converge to suggest publication bias is not problematic in this study.

4. Discussion and Conclusions

4.1 Discussion

This is the first systematic review and meta-analysis of the efficacy of MI across medical care settings. Overall, MI showed beneficial effects, with 63% of main outcome comparisons in these studies yielding statistically significant advantages favoring MI. The omnibus OR suggests a 55% increased chance of MI producing a positive outcome relative to comparison interventions, which were mostly treatment-as-usual groups (55%) or waitlist (14%) or information-only controls (31%).

MI produced a statistically significant and positive impact on a range of outcome measures of interest to medical providers, including dental caries, death rate, cholesterol level, blood pressure, HIV viral load, body weight, physical strength, quality of life, amount of alcohol consumed, dangerous drinking, smoking abstinence, marijuana use, self-monitoring, sedentary behavior, patient confidence, intention to change, and engagement in treatment. However, MI

did not show a statistically significant effect on safe sex behaviors, heart rate, blood glucose, healthy eating, eating disorder behavior, injury prevention, functional independence post-stroke, marijuana abstinence, medication adherence, self-care, or breast feeding.

Moderator analyses suggest MI is robust. MI is deliverable with or without assessment feedback by different types of medical providers, regardless of amount of training or supervision, across a wide variety of medical settings to patients with differing demographic characteristics and stages of disease. In fact, the only moderators that significantly accounted for differential effect sizes were targeted medical outcome type, measurement type (with self-report measures showing the strongest effects), fidelity (inversely), and, to a certain extent, dosage of MI. Positive effects in these studies were durable, with statistically significant effect sizes found more than a year following intervention and no indication of publication bias.

4.1.1. Limitations

Some relevant studies may not have been identified or were excluded because of our tight inclusion criteria (57). Further, not including unpublished works may have biased the results even though our publication bias analyses suggest otherwise. Within included studies, several medical outcomes included few studies, making effect sizes estimates unstable. Further, it was often difficult to determine the type of intervention to which MI was compared. Also, only eight studies assessed fidelity of MI delivery, calling into question what use of MI actually means. Fortunately, included studies had high external validity (i.e., they were in real-world clinics) and the mechanism of MI was not at issue here. As well, typically only 3.5% of studies assess fidelity adequately across the broad field of psychotherapy research (58).

4.1.2 Comparison with other findings

To date, four general meta-analyses of MI across problem types and settings have been published (15, 17, 18, 19). These included studies outside of medical care settings and provide strong evidence that treatment outcomes for patients receiving MI interventions **are** superior to comparison interventions (OR of about 1.4 to 1.5). The present study found an omnibus OR of 1.55 (95% CI 1.40-1.71) for MI in medical care, which is similar to the ORs found in these general reviews. Thus, MI works just as well in medical care settings as in the substance abuse and specialty clinics.

Four further meta-analyses for MI in specific problem areas have been published. One on problem drinking (20) included 15 studies and yielded an OR of 1.66 (95% CI 1.53 to 4.66). In the current study, we found an even higher OR for MI with alcohol use of around 2.00 (95% CI from 1.33 to 3.06), indicating this remains one of MI's most appropriate targets and perhaps even most opportune within medical care settings. Two recent meta-analyses of MI and smoking have been conducted: One (22) yielded an OR for MI of 1.45 (95% CI 1.14 to 1.83) and the other (23) an OR of 1.35 (95% CI 1.02 to 1.78), both similar to our OR of 1.34 (95% CI 1.05 to 1.70) for MI on smoking abstinence.

The newest published meta-analysis of MI targeted obesity (24). This review included 11 studies wherein 50 to 323 minutes of MI were typically employed as an adjunct to standard dietary care or, in about half the studies, a behavioral weight management program. Combined OR for weight loss, blood pressure reductions, and/or increases in physical activity was a high but non-significant 1.90 (95% CI .99 to 3.53) for MI compared to standard care. With a larger number of studies, we found significant positive effects for MI in each of those areas separately: ORs of 1.47 (95% CI 1.19 to 1.81) for exercise, 1.17 (95% CI 1.09 to 1.27) for weight loss, and 1.65

(95% CI 1.24 to 2.19) for blood pressure reductions. Thus, obesity represents a key medical domain in which MI is likely to be valuable.

4.2 Conclusion

The central implication of our findings is that MI can profitably be delivered by a range of professionals with a minimum investment of time in medical care settings in a variety of formats and time frames for patients of different ages, genders, and ethnicities. Our review suggests medical providers can use MI to help patients exercise more, lose weight, lower HIV viral load, blood pressure and cholesterol, reduce problematic substance use (perhaps even more effectively than in non-medical settings), and boost self-efficacy in their ability to make health-related behavioral changes.

4.3. Practice Implications

MI researchers have come a long way toward understanding its mechanism of action—a supportive relationship combined with the evocation of patient change talk (59). However, understanding why MI failed to impact some but not other medical outcomes is complex. The simplest explanation is that the low number of studies in certain problem areas resulted in positive but non-significant effect sizes for MI; in fact, with one exception, all targeted outcomes not yielding significant effects had fewer than four studies. The exception was in the area of healthy eating, where MI failed to produce any discernible advantage across 6 studies. Upon closer scrutiny, the 3 effects sizes contributing most heavily to the non-significant effect for MI came from two studies which did not include face-to-face contact between MI providers and patients. One (60) used only web-based MI that relied upon email and the relied only on telephone MI (61).

Another important target for which MI did not produce measurable benefits overall was medication adherence. For example, MI did not improve medication adherence for patients with epilepsy (53) but it did for those with HIV-AIDS (62) and at 3-month but not 1-year follow-up for prescription drug abusers (55, 63). Again, the study not yielding significant effects for MI utilized a telephone-only format (53). It would therefore be premature to conclude that MI is not worth using to bolster medication adherence or healthy eating until further research is conducted with face-to-face treatment.

In examining moderators, fidelity was inversely related to outcome such that studies measuring MI fidelity produced *lower* effect sizes (OR = 1.19) than those that did not (OR = 1.64). This may be cause for sobering reflection, as studies producing the strongest effects may or may not have been faithfully delivering MI as designed. However, this finding could also indicate that MI is easy to implement in real-world settings and has positive effects for patients even without time-intensive supervision or fidelity monitoring. Future studies that seek to explain findings or add to intervention refinement and development should conduct thorough process evaluations.

Another interesting finding relates to the duration of patient exposure to MI. Whereas the total amount of time participants received MI interventions approached significance ($p = .06$) the number of MI sessions was unrelated to outcome, suggesting that longer time in a single MI visit may promote better outcomes. Providers may need to invest slightly more time in each visit to realize the full benefits of MI. In a recent study of MI at a general medical clinic, MI training increased physician visit length by about 10% while producing significant reductions in patient depression (64).

What about the clinical significance? Overall, patients receiving MI had one and half times the chance of improving on a wide variety of health measures compared to control groups. The take home point is: No matter what your professional training or where you work, if you can devote a small amount of extra time with your patients to build relationship and evoke change talk, you can expect 10-15% (as per our BESD analyses above) additional improvement across a wide variety of behaviors and medical outcomes.

Declaration of Competing Interest

All authors have completed the Unified Competing Interest form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and we declare that (1) none of the authors has support from an external source to produce this systematic review; (2) none of the authors have relationships with those that might have an interest in the submitted work in the previous 3 years; (3) their spouses, partners, or children do not have financial relationships that may be relevant to the submitted work; and (4) none of the authors have non-financial interests that may be relevant to the submitted work.

The authors made the following contributions:

Brad Lundahl PhD: Study design, searching and coding studies, analysis, writing
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Each author has access to the raw and computed data for each study insuring the integrity of the data and accuracy of data analysis.

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Table 1
Descriptive Statistics

	K	Mean (SD)	Median	Min / Max
Total minutes in treatment				
MI	43	106.01 (92.39)	79.00	15 - 480 min
Comparison/Waitlist	40	29.98 (72.39)	0.00	0 - 300 min
Face-to-face sessions				
MI	45	2.60 (1.95)	3.00	1 – 10 sessions
Phone sessions				
MI	20	3.00 (1.92)	2.50	0 – 7 sessions
Hours to train providers in MI	24	17.92 (11.39)	18.00	4 – 40 hours
Rigor rating of studies	51	12.51 (2.59)	12.50	7 – 17

Note. K = number of studies contributing data. OR = Odds Ratio. SD = Standard Deviation. Three studies delivered MI via phone without face-to-face interactions; 17 studies utilized a combination of phone and face-to-face delivery of MI.

Table 2

Overview of studies

Study (first author only)	Setting	Targeted outcomes	OR	Limits 95%	p-value	n's MI / Comp
Ahluwalia (2006)	Community health	Tobacco	0.98	0.86 / 1.12	0.730	189 / 189
Alexander (2010)	Cancer network	Eating fruits, vegetables	0.98	0.85 / 1.13	0.740	661 / 671
Bernstein (2009)	Emergency Dept	Marijuana	2.80	1.85 / 4.26	0.001*	47 / 55
Bowen (2002)	Women Hlth Center	Eating: energy from fat	2.33	1.50 / 3.63	0.001*	82 / 82
Brodie (2008)	Hospital	Chronic heart failure: life quality	7.57	5.14 / 11.14	0.001*	22 / 18
Brug (2007)	Home health	Diabetes: eating, weight	1.33	1.04 / 1.71	0.023*	83 / 59
> Campbell x WL (2007)	Cancer network	Eating fruits, vegetables	1.13	0.86 / 1.49	0.893	109 / 120
>Campbell x TAU (2007)	Cancer network	Eating fruits, vegetables	1.08	0.82 / 1.43	0.579	109 / 110
Chacko (2010)	Primary care	Safe sex practices	1.30	0.88 / 1.90	0.186	90 / 78
Colby (2005)	Hospital	Tobacco	1.29	1.02 / 1.64	0.036*	43 / 42
D'Amico (2008)	Primary care	Alcohol, marijuana	3.20	1.97 / 5.20	0.001*	20 / 22
Dilorio (2009)	Epilepsy clinic	Self-management, confidence	1.18	0.72 / 1.92	0.512	10 / 10
Emmen (2005)	Primary care	Alcohol	1.16	0.78 / 1.74	0.456	61 / 62
Ershoff (1999)	Prenatal care	Tobacco use during pregnancy	1.00	0.75 / 1.35	0.984	101 / 111
Gentilello (1999)	Emergency Dept	Injury prevention	1.21	1.01 / 1.44	0.034*	205 / 205
Golin (2006)	HIV disease clinic	Adherence to Antiretroviral tx	1.58	1.00 / 2.49	0.049*	49 / 52
Habib (2005)	Primary care etc	Self-management: pain	4.18	1.60 / 10.94	0.004*	39 / 39
Hardcastle (2008)	Primary care	Diet, physical activity: obesity	1.30	1.16 / 1.46	0.001*	203 / 131
>Hillsdon x TAU (2002)	Primary care	Exercise, heart-rate, BMI	1.23	1.07 / 1.41	0.003*	177 / 319
>Hillsdon x WL (2002)	Primary care	Exercise	1.55	1.11 / 2.17	0.010*	177 / 178
Ismail (2008)	Hospital	Diabetes: blood glucose; self mgmt	1.11	0.98 / 1.26	0.088	121 / 117
Johnston (2002)	Emergency Dept	Injury prevention	1.25	1.05 / 1.47	0.010*	234 / 238
Katzman (2010)	Hospital/Eating D/O	Eating disorder; binge; laxative	0.69	0.42 / 1.14	0.150	28 / 17
Lloyd-Richardson (2009)	Primary care +	Tobacco among HIV + group	0.02	0.58 / 1.42	0.655	116 / 113
Magill (2009)	Emergency dept	Marijuana	3.07	2.01 / 4.69	0.001*	25 / 33

>Maisto x TAU (2001)	Primary care	Alcohol	3.90	3.15 / 4.82	0.001*	73 / 85
>Maisto x TAU (2001)	Primary care	Alcohol	2.34	1.82 / 3.02	0.001*	73 / 85
Mhurchu (1998)	Hospital diet clinic	Cholesterol, BMI	0.97	0.70 / 1.33	0.827	47 / 50
Naar-King (2006)	Hospital: HIV clinic	HIV viral load; drugs; safe sex, etc	2.43	1.41 / 4.20	0.001*	19 / 26
Naar-King (2008)	Hospital: HIV clinic	HIV viral load; drugs; safe sex, etc	1.84	1.09 / 3.10	0.022*	22 / 25
Noknoy (2010)	Primary care	Alcohol: hazardous drinkers	2.51	2.09 / 3.03	0.001*	50 / 48
Otto (2009)	Hospital	Prescription drug adherence	1.05	0.83 / 1.33	0.699	56 / 56
Paradis (2010)	Hospital	Heart failure: self-care, efficacy	1.62	0.84 / 3.15	0.153	12 / 13
Rosenbek Minet (2011)	Hospital: diabetes	BMI, Cholesterol, heart rate, etc	1.05	1.00 / 1.10	0.069	149 / 149
Rubak (2009)	Primary care	Diabetes: engagement in self-care	1.18	1.06 / 1.32	0.003*	133 / 132
Schermer (2006)	Emergency dept	Alcohol: dangerous drinking	2.20	0.82 / 5.89	0.117	64 / 62
Sentf (1997)	Primary care	Alcohol	1.26	1.12 / 1.42	0.001*	196 / 215
Smith (1997)	Other: Diabetes	Diabetes self-care, weight, GHb,etc	6.16	2.92 / 13.00	0.001*	6 / 10
Soares de Azevedo (2010)	Hospital	Tobacco	1.47	1.25 / 1.74	0.001*	107 / 108
Soria (2006)	Primary care	Tobacco	6.25	2.59 / 15.07	0.001*	114 / 86
Stotts (2002)	Hospital	Tobacco: pregnant smokers	1.03	0.75 / 1.43	0.841	82 / 84
Van Voorhees (2009)	Primary care	Depression: engagement in tx	2.08	1.30 / 3.35	0.002*	42 / 43
Vong (2011)	Physical therapy	Strength, adherence, life quality	1.92	1.33 / 2.77	0.001*	38 / 38
Watkins (2007)	Hospital: Stroke	Fxn independence, mortality, etc	1.18	1.01 / 1.37	0.041*	172 / 167
Watkins (2011)	Hospital: Stroke	Fxn independence, mortality, etc	1.18	0.99 / 1.40	0.071	18 / 12
Weinstein (2004)	Dental practice	Preventing caries	1.74	1.10 / 2.77	0.019*	119 / 119
Weinstein (2006)	Dental practice	Preventing caries	2.01	1.15 / 3.53	0.015*	103 / 102
West (2007)	Other: Diabetes	Weight, GHb, self-care, reporting	1.58	1.41 / 1.77	0.001*	103 / 92
Wilhelm (2005)	Hospital	Breastfeeding	1.48	0.73 / 3.01	0.273	34 / 28
Wu (2009)	Home health	Tobacco, confidence	1.68	1.35 / 2.08	0.001*	60 / 62
Zahradnik (2009)	Hospital	Prescription medicine adherence	2.21	1.22 / 4.00	0.009*	55 / 62

Note: Comp = Comparison Group; Fxn = functional; Hlth = health; MI = Motivational Interviewing Group; STD = Sexually transmitted disease; WL = Waitlist; tx = treatment; TAU = Treatment as Usual.
* $p < .05$; > = Study has two comparison groups.
All studies are located in the 2nd reference section with a "*" by the first author's name.

Table 3

MI Effects: Overall and by Medical Outcome Category

Targeted Outcome	k	(n)	OR	CI	z-value	Hetero-geneity	BESD % Improved MI	BESD % Improved Comparison
Overall								
Omnibus effect	51	(312)	1.55**	1.40 / 1.71	8.67	Yes	56	44
Targeted Medical Outcomes								
Prognostic markers								
Blood Glucose	5	(12)	1.17	0.82 / 1.67	0.85	Yes	52	48
Blood Pressure	1	(02)	1.65**	1.24 / 2.19	3.45	No	57	43
Cholesterol	3	(12)	1.09*	1.00 / 1.19	1.92	No	51	49
Heart rate	2	(06)	1.00	0.87 / 1.14	-0.02	No	50	50
HIV viral load	3	(03)	2.15**	1.18 / 3.91	2.51	No	60	40
Disease endpoints								
Dental (carries)	2	(02)	1.85**	1.29 / 2.64	3.36	No	58	42
Death rate	3	(03)	1.87*	1.03 / 3.40	2.06	No	59	41
Risk reduction behaviors								
Safe sex behavior	3	(06)	1.42	0.99 / 2.03	1.89	No	55	45

Eating healthy	6	(12)	1.16	0.94 / 1.43	1.39	Yes	52	48
Eating disorder behavior	1	(06)	0.74	0.39 / 1.40	-0.94	No	46	54
Injury prevention	1	(10)	1.28	0.97 / 1.69	1.71	No	53	47
Body weight	10	(19)	1.17**	1.09 / 1.27	4.22	No	52	48
Physical functioning and quality of life								
Physical strength	1	(02)	1.78*	1.00 / 3.18	1.95	No	58	42
Functional independence (post stroke)	2	(06)	1.09	0.87 / 1.36	0.73	No	51	49
Quality of life	6	(21)	2.21**	1.65 / 2.96	5.28**	Yes	62	38
Substance use								
Alcohol								
Amount	9	(38)	2.31**	1.75 / 3.06	5.86	Yes	61	39
Dangerous Use	4	(16)	1.83**	1.33 / 2.53	3.69	Yes	58	42
Smoking Tobacco								
Abstinence	8	(38)	1.34*	1.05 / 1.70	2.38	Yes	54	46
Amount	4	(12)	1.18	0.96 / 1.45	1.59	Yes	52	48
Marijuana								
Amount	5	(11)	3.22**	2.14 / 4.84	5.60	Yes	65	35
Abstinence	1	(02)	1.99	0.81 / 4.86	1.51	No	60	50
Adherence to medical advice/protocol								
Self monitoring	4	(13)	2.14**	1.65 / 2.79	5.67	Yes	61	39
Medication adherence	4	(10)	1.25	0.95 / 1.65	1.61	No	53	47
Self care	2	(05)	0.64	0.33 / 1.27	-1.27	No	44	56
Sedentary behavior	5	(07)	1.47**	1.19 / 1.81	3.62	Yes	55	45
Breast feeding	1	(02)	1.48	0.73 / 3.01	1.10	No	55	45

Approach to change and treatment								
Confidence / efficacy	7	(17)	1.39**	1.09 / 1.78	2.63	Yes	55	45
Intention to change	5	(05)	1.97**	1.11 / 3.48	2.53	No	59	41
Engagement	5	(14)	1.38**	1.18 / 1.62	4.04	Yes	55	43

Note. Tx = Treatment.
K = number of studies. OR = Odds Ratio. CI = 95% confidence interval.
n = effect sizes contributing to Odds Ratio and associated statistics
Heterogeneity: “Yes” or “No” reflects significance based on I-squared values.
% Improved based on BESD (Randolph & Edmondson, 2005).
“Difference” column was calculated by % Improved MI Group minus % Improved Comparison Group
HIV = Human Immunodeficiency Virus
** $p <$ .001; * $p <$ .05

Table 4

MI Effects by Delivery Site and Provider Type

Site/Provider	k	n	OR	Limits	z	p	Hetro	BESD
								% Improved MI / C
Delivery Site								
Dental clinic	2	2	1.85**	1.29 / 2.64	3.36	.001	No	58 / 42
Emergency Department	5	23	1.83**	1.27 / 2.64	3.24	.001	Yes	59 / 41
Clinic with HIV treatment	3	11	1.57	0.86 / 2.86	1.47	.142	No	56 / 44
Home health	2	18	1.51*	1.21 / 1.89	3.61	.001	Yes	56 / 44
Hospital	16	120	1.39*	1.16 / 1.66	3.56	.001	Yes	55 / 45
Physical therapy	1	5	1.92*	1.33 / 2.77	3.46	.001	No	59 / 41
Physician office / clinic	16	98	1.69*	1.39 / 2.05	5.27	.001	Yes	58 / 42
Provider Type								
Dietician	3	14	1.41	0.92 / 2.15	1.56	.118	Yes	55 / 45
Physician	2	6	2.56	0.50 / 13.05	1.13	.259	Yes	62 / 38
Mental health professional	13	73	1.73*	1.42 / 2.10	5.53	.001	Yes	58 / 42
Mixed	9	68	1.23*	1.08 / 1.40	3.11	.002	Yes	55 / 45
Nurse	6	56	1.41	0.95 / 2.10	1.70	.090	Yes	55 / 45

Note. k = number of studies; n = number of effect sizes derived from each setting. Some studies could not be reliably coded into a single category. Hetro = Heterogeneity. BESD = Binomial Effect Size Display. MI = Motivational Interviewing condition. C = Comparison Condition.
** $p <$ .001; * $p <$ .05

Table 5

MI Effects by Follow-up Period

Durability	k	n	OR	Limits	z	p	Hetro	BESD
								% Improved MI / C
Immediate – 1 month	13	47	1.38**	1.16 / 1.65	3.61	.001	Yes	55 / 45
5 weeks – 6 months	29	163	1.72**	1.55 / 1.91	10.30	.001	Yes	58 / 42
7 – 12 months	21	85	1.34**	1.22 / 1.48	5.85	.001	Yes	55 / 45
13 + months	5	17	1.14*	1.03 / 1.28	2.40	.016	Yes	52 / 48

Note. k = number of studies; n = number of effect sizes derived from each setting. Some studies could not be reliably coded into a single category. Hetro = Heterogeneity. BESD = Binomial Effect Size Display. MI = Motivational Interviewing condition. C = Comparison Condition.
** $p <$ .001; * $p <$ .05

Table 6

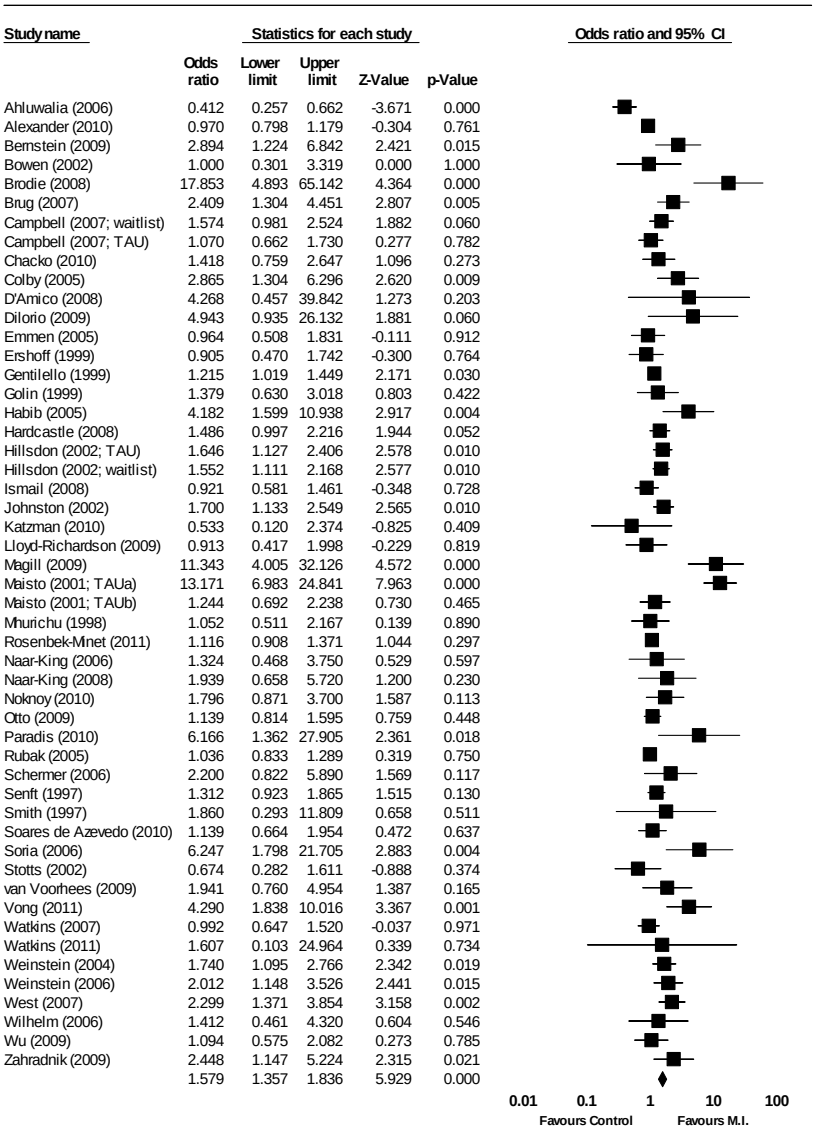
Potential Continuous Moderators of MI effects

Moderator	k	z-value	p	Slope / Intercept
Degree of exposure to MI				
Number of MI counselling sessions: in person	44	0.76	.45	.03 / .47
Number of MI counselling sessions: via phone	18	- 0.54	.16	- .03 / .43
Total minutes of MI intervention	42	1.90	.06	.00 / .34
Provider training in MI				
Total minutes spent training provider in MI	23	0.17	.86	.01 / .25
Patient characteristics				
Patient average age	46	0.18	.85	.00 / .42
% of Caucasians in sample (USA only):	29	- 0.46	.65	.00 / .48
% of males in sample	37	0.94	.35	.00 / .35
Study quality				
Study rigor rating	50	- 0.04	.97	.00 / .52

Note. k = number of studies. As not all studies contributed data for all moderators, k is often less than 54.

Figure 1

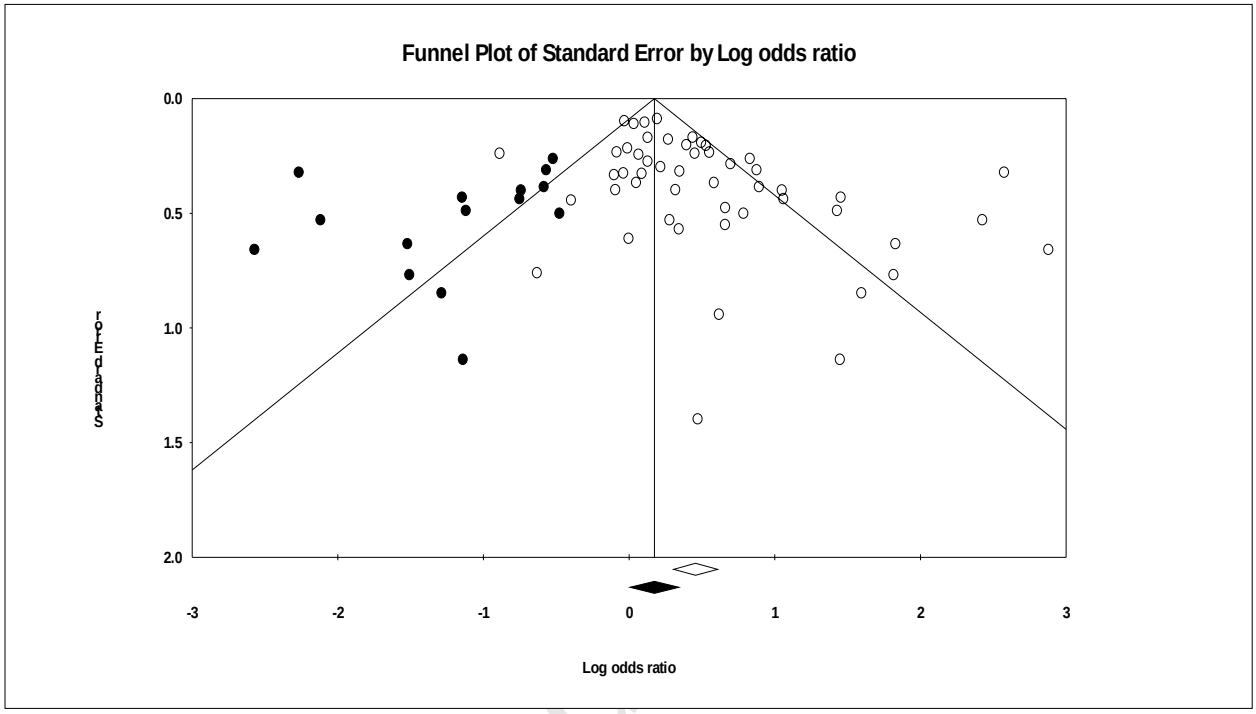
Forrest Plot of Effects at Study Level



Study name	Odds ratio	Lower limit	Upper limit	Z-Value	p-Value
Ahluwalia (2006)	0.412	0.257	0.662	-3.671	0.000
Alexander (2010)	0.970	0.798	1.179	-0.304	0.761
Bernstein (2009)	2.894	1.224	6.842	2.421	0.015
Bowen (2002)	1.000	0.301	3.319	0.000	1.000
Brodie (2008)	17.853	4.893	65.142	4.364	0.000
Brug (2007)	2.409	1.304	4.451	2.807	0.005
Campbell (2007; waitlist)	1.574	0.981	2.524	1.882	0.060
Campbell (2007; TAU)	1.070	0.662	1.730	0.277	0.782
Chacko (2010)	1.418	0.759	2.647	1.096	0.273
Colby (2005)	2.865	1.304	6.296	2.620	0.009
D'Amico (2008)	4.268	0.457	39.842	1.273	0.203
Dilorio (2009)	4.943	0.935	26.132	1.881	0.060
Emmen (2005)	0.964	0.508	1.831	-0.111	0.912
Ershoff (1999)	0.905	0.470	1.742	-0.300	0.764
Gentilello (1999)	1.215	1.019	1.449	2.171	0.030
Golin (1999)	1.379	0.630	3.018	0.803	0.422
Habib (2005)	4.182	1.599	10.938	2.917	0.004
Hardcastle (2008)	1.486	0.997	2.216	1.944	0.052
Hillsdon (2002; TAU)	1.646	1.127	2.406	2.578	0.010
Hillsdon (2002; waitlist)	1.552	1.111	2.168	2.577	0.010
Ismail (2008)	0.921	0.581	1.461	-0.348	0.728
Johnston (2002)	1.700	1.133	2.549	2.565	0.010
Katzman (2010)	0.533	0.120	2.374	-0.825	0.409
Lloyd-Richardson (2009)	0.913	0.417	1.998	-0.229	0.819
Magill (2009)	11.343	4.005	32.126	4.572	0.000
Maisto (2001; TAUa)	13.171	6.983	24.841	7.963	0.000
Maisto (2001; TAUb)	1.244	0.692	2.238	0.730	0.465
Mhurichu (1998)	1.052	0.511	2.167	0.139	0.890
Rosenbek-Minet (2011)	1.116	0.908	1.371	1.044	0.297
Naar-King (2006)	1.324	0.468	3.750	0.529	0.597
Naar-King (2008)	1.939	0.658	5.720	1.200	0.230
Noknoy (2010)	1.796	0.871	3.700	1.587	0.113
Otto (2009)	1.139	0.814	1.595	0.759	0.448
Paradis (2010)	6.166	1.362	27.905	2.361	0.018
Rubak (2005)	1.036	0.833	1.289	0.319	0.750
Schermer (2006)	2.200	0.822	5.890	1.569	0.117
Senft (1997)	1.312	0.923	1.865	1.515	0.130
Smith (1997)	1.860	0.293	11.809	0.658	0.511
Soares de Azevedo (2010)	1.139	0.664	1.954	0.472	0.637
Soria (2006)	6.247	1.798	21.705	2.883	0.004
Stotts (2002)	0.674	0.282	1.611	-0.888	0.374
van Voorhees (2009)	1.941	0.760	4.954	1.387	0.165
Vong (2011)	4.290	1.838	10.016	3.367	0.001
Watkins (2007)	0.992	0.647	1.520	-0.037	0.971
Watkins (2011)	1.607	0.103	24.964	0.339	0.734
Weinstein (2004)	1.740	1.095	2.766	2.342	0.019
Weinstein (2006)	2.012	1.148	3.526	2.441	0.015
West (2007)	2.299	1.371	3.854	3.158	0.002
Wilhelm (2006)	1.412	0.461	4.320	0.604	0.546
Wu (2009)	1.094	0.575	2.082	0.273	0.785
Zahradnik (2009)	2.448	1.147	5.224	2.315	0.021
	1.579	1.357	1.836	5.929	0.000

Figure 2

Funnel Plot related to publication bias.



Optional Figure

Flow Diagram of Study Selection Strategy