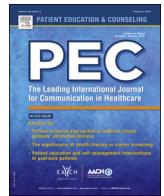




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## Review article

# Motivational interviewing to improve health screening uptake: A systematic review

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### ABSTRACT

**Objective:** Health screenings, physical tests that diagnose disease, are underutilized. Motivational interviewing (MI) may increase health screening rates. This paper systematically reviewed the published articles that examined the efficacy of MI for improving health screening uptake.

**Methods:** Articles published before April 28, 2015 were reviewed from PubMed, PsycINFO, and CINAHL. Study methodology, participant demographics, outcomes and quality were extracted from each article. **Results:** Of the 1573 abstracts, 13 met inclusion criteria. Of the 13 studies, 6 found MI more efficacious than a control, 2 found MI more efficacious than a weak control yet equivalent to an active control, and 3 found MI was not significantly better than a control. Two single arm studies reported improvements in health screening rates following an MI intervention.

**Conclusions:** MI shows promise for improving health screening uptake. However, given the mixed results, the variability amongst the studies and the limited number of randomized trials, it is difficult to discern the exact impact of MI on health screening uptake.

**Practice implications:** Future research is needed to better understand the impact of MI in this context. Such research would determine whether MI should be integrated into standard clinical practice for improving health screening uptake.

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1. Introduction

Health screenings are clinical tests that can be used to diagnose disease, often before symptoms are present. Health screenings are important in the detection of early stage disease, and thus can aid in the prevention of both disease progression and mortality. A wide range of diseases including, diabetes, hypertension, sexually transmitted infections, and some types of cancers can be detected through the use of health screenings. Despite their importance, health screenings remain underutilized. For example, in the United States, more than one-third (35.5%) of adults aged 50–75 have not received a colorectal cancer screening within the recommended time frame (e.g., a screening colonoscopy every ten years) [1]; 64% of adults over the age of 18 have never received an HIV test [2]; and 27.6% of women aged 50–74 have not received a mammogram within a two year timeframe [3]. It is critical to implement interventions to improve the uptake of health screenings across the United States.

Motivational interviewing (MI) may help improve the uptake of health screenings. MI is defined as “a collaborative conversation style for strengthening a person’s own motivation and commitment to change.” (p. 12) [4]. The intervention is client-centered and helps individuals acknowledge and resolve any ambivalence they might have to change. In the most recent edition of their book, Miller and Rollnick describe that MI involves four processes: (1) *engaging* the patient in order to form a strong working relationship, (2) *focusing* the goal or direction of the conversation, (3) *evoking* the patient’s own motivations for change, and (4) *planning* for change by increasing the patient’s commitment to change and then developing an action plan [4]. The four processes are not necessarily linear and MI interventionists often move from one process to another. Unlike unidirectional advice giving, MI practitioners use client-centered communication skills, including asking open ended questions, affirming the client’s strengths and previous successes, reflective listening, summarizing, and informing/advising [4].

MI was originally developed to treat substance use, and extensive research supports its efficacy for treating drug, alcohol, and nicotine use [5–8]. More recently, MI has been implemented in healthcare settings to help patients reduce risky behaviors and increase healthy behaviors. Previous systematic reviews and meta-analyses have examined MI’s efficacy for improving health behaviors. The results of those reviews and meta-analyses found that, although the literature is mixed, MI demonstrates promise in the healthcare arena and, in particular, may help improve behaviors such as diet and exercise, diabetes management, and oral health [6,9–15]. In fact, two meta-analyses reported that MI had significant impacts on physical outcomes (e.g., BMI reduction [16], dental outcomes, HIV viral load [17]).

To our knowledge, no systematic review has examined the efficacy of MI to improve health screening uptake. Health screenings are a key component of disease prevention and it is imperative to understand whether MI can effectively help individuals complete these important screenings. This article will systematically review the published intervention studies that examined the efficacy of MI for improving physical health screening uptake.

2. Methods

2.1. Search strategy

Articles were reviewed from three electronic databases (PubMed, PsycINFO, and CINAHL) that were published on or before April 28, 2015. The search terms varied based on the available search words in the each electronic database. For PubMed, the search terms were ((“Mass Screening”[Mesh]) AND (“Motivation”[Mesh] OR “Motivational Interviewing”[Mesh] OR “Counseling”[Mesh] OR “Intervention Studies”[Mesh])). The search was limited by language (English), methodology (case reports, clinical trial phase I–IV, comparative study, controlled clinical trial, evaluation studies, interview, randomized controlled trial, technical report), and sample (humans). Only articles that had a published abstract available were reviewed. This search yielded 448 abstracts.

For PsycINFO, the search terms were ((exp health screening) AND (exp counseling OR exp motivational interviewing OR exp intervention OR exp motivation)). This search was limited by language (English), methodology (clinical case study, empirical study, experimental replication, follow-up study, longitudinal study, prospective study, retrospective study, field study, interview, focus group, nonclinical case study, qualitative study, quantitative study, treatment outcome/clinical trial) and sample (humans). This search yielded 909 abstracts.

For CINAHL, the search terms were ((MH motivation OR MH motivational interviewing OR MH intervention OR MH counseling) and (MH health screening)). This search was limited by language (English), publication type (academic journal), and subjects (humans). Only articles that had a published abstract were reviewed. This search yielded 216 abstracts.

2.2. Selection strategy

In total, 1573 abstracts were identified through the electronic database search. After removing duplicates, two coders independently reviewed 1476 abstracts to consensus on the following inclusion criteria: (1) implemented an MI intervention (e.g., motivational interviewing, motivational enhancement); and (2) included a health screening as an outcome of the study. Although there are screenings for mental health/behavioral health (e.g., depression screenings, substance abuse screenings), this search was limited to physical health screenings (e.g., cancer screenings, HIV test). In total, 27 abstracts met the aforementioned inclusions criteria. Next, those 27 articles were read in entirety by two independent coders to determine whether they met the inclusion criteria. An additional two articles were reviewed in entirety based on the coders’ familiarity with the first author’s research. These two articles, both published by Manne, were included in the 1476 abstracts reviewed; however, they did not discuss the incorporation of MI the abstract and thus were missed in the first round of reviews. After the 29 articles were read and reviewed, an additional 16 articles were excluded because they did not meet eligibility criteria (e.g., implementation studies). In total, 13 articles were included in the final systematic review. See Fig. 1 for a flow diagram of the reviewed articles, in accordance with the PRISMA guidelines [18,19].

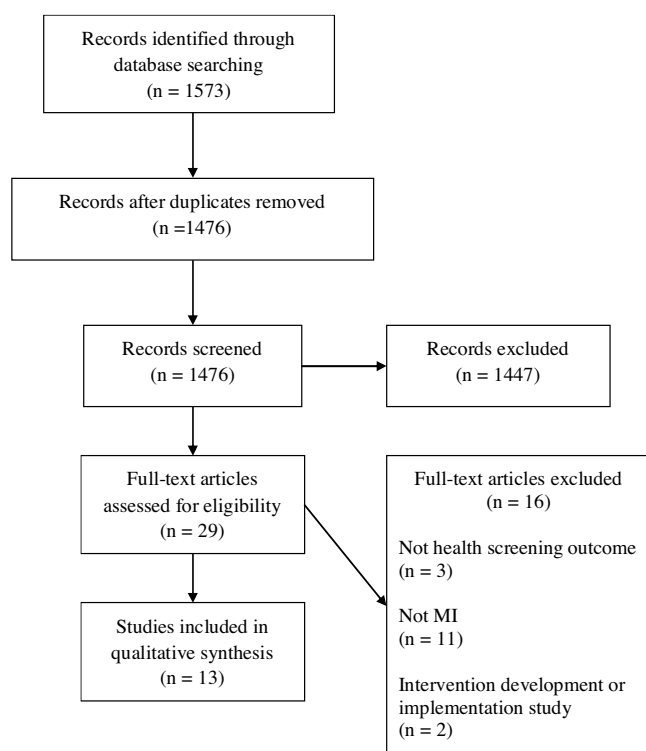


Fig. 1. PRISMA Flow Diagram.

### 2.3. Data extraction

A data extraction sheet was used to gather the following information: (1) authors and publication date; (2) participant information (i.e., sample size, race, age, gender); (3) research design (e.g., randomized controlled trial); (4) description of the MI intervention; (5) dose of the MI intervention; (6) description of the comparison group (s); (7) health screening outcome; and (8) major findings and effect sizes.

Each study's quality was evaluated to consensus by two independent coders. A quality assessment, adapted from previous literature [20–22], was used to assess the follow criteria: (1) groups were randomized, (2) groups were similar at baseline (or differences were statistically controlled for in the analyses), (3) eligibility criteria was described, (4) identification of withdrawals and dropouts, (5) intention to treat analysis was implemented; (6) fidelity of the intervention was monitored. Each item was scored (0 = no/not reported; 1 = yes) and then all items were summed to create a total quality score (range 0–6).

There was significant variability in the quality and methodologies in the articles, and thus a meta-analysis was not performed. Available effect sizes are reported in the results.

## 3. Results

### 3.1. Participant characteristics

The participant demographics from each of the 13 studies are delineated in Table 1.

### 3.2. Study characteristics

The majority of the studies examined the impact of MI on either cancer screening uptake (N=8) or HIV testing (N=3). The remaining two studies examined the effect of MI on attendance of a hepatitis C screening appointment and on receipt of a

screening for sexually transmitted infections. Although all of the studies included in the review implemented some form of MI, the type of MI varied. For example, the dose of the interventions ranged from a one-time 6-min phone call to a multi session intervention. Furthermore, there was notable variability in the MI interventions' modes of delivery. Approximately half of the studies implemented the intervention over the telephone, while other studies implemented MI face-to-face or via computer. Two studies did not explicitly report the MI interventions' modes of delivery. Moreover, the majority of the studies (N=9) delivered MI in combination with another intervention (e.g., print materials, educational presentations).

### 3.3. Study quality

The overall quality of the research studies, as defined by our quality scoring assessment, varied amongst the studies. The summed scores ranged from one to six (M=4.38, Median=5). Of the studies, 11 were randomized clinical trials, 8 had similar groups at baseline (or statistically controlled for differences in the analyses), 12 described eligibility criteria, 6 conducted fidelity monitoring, 8 conducted intent-to-treat analyses, and 12 identified withdrawals and dropouts. The total quality scores are reported in Table 2.

### 3.4. Main effect of MI on health screening uptake

Several studies examined the impact of MI on multiple behaviors, however, only the results relevant to health screening uptake are reported and analyzed in the current paper. Overall, the results regarding the impact of MI on health screening uptake were mixed. Six studies [23–28] reported that MI significantly improved health screening uptake, when compared to a control group. Furthermore, two single arm studies [29,30] reported an increase in health screening rates after receiving the MI intervention.

Two studies reported that MI performed significantly better than a minimal comparison group, yet did not provide additional benefit when compared to an active control group. In particular, Taplin and colleagues [31] found that an MI telephone call was more efficacious than a reminder postcard to improve mammography uptake; however, the MI call was no more efficacious than a reminder telephone call. Additionally, Manne and colleagues [32] found that participants who received tailored print materials and an MI counseling telephone call were more likely to receive colorectal cancer screening than participants who received a generic print intervention. The MI intervention, however, did not provide additional benefit to a tailored print material alone.

Finally, three studies (23%) [33–35] did not find a significant impact of MI on health screening uptake. The results of the studies are reported in Table 2.

## 4. Discussion and conclusion

### 4.1. Discussion

Although the systematic review produced mixed results, overall MI holds promise for improving health screening uptake. Six of the thirteen studies found that an MI intervention was able to significantly improve health screening uptake, compared to a control group. In particular, these studies found MI efficacious for improving mammography, pap smears, HIV testing/counseling, colorectal cancer screenings, and total cutaneous skin examinations. Five of these six studies had quality ratings of five or greater. These studies support the clinical integration of MI to help improve health screening uptake. Of note, one of the six studies [24] found that individuals who received a tailored intervention which

**Table 1**  
Participant Demographics.

Source	Sample size	% Non-white	% White	% Male	Age
<i>MI improves health screening, RCT</i>					
Outlaw et al. [25]	188	100% African American	0%	100%	Range = 16–24 Mean = 19.79 SD = 2.2
Valanis et al. [27] <sup>b</sup>	501	Not reported	Not reported	0%	Range = 50–69 Mean = 47.6 SD = 13.2
Manne et al. [25]	443	1.8% Non-Caucasian	98.2%	37%	Mean = 44.7–45.0 SD = 9.8–10.3
Masson et al. [23] <sup>b</sup>	489	28.6%–32% Hispanic 27.5%–31.4% African American 4.1%–11% Other	35.9%–36.1%	68.2%–68.4%	
Fortuna et al. [28] <sup>c</sup>	1008	<b>Mammography Screening</b> 36.2%–43.4% Non-Hispanic Black 10.9%–21.1% Other (including Hispanic)	<b>Mammography Screening</b> 42.2%–47.7%	<b>Mammography Screening</b> 0%	<b>Mammography Screening</b> Aged 40–49 = 46.8%–53.1% Aged 50–59 = 27.2%–32.0% Aged 60+ = 15.0%–23.7%
		<b>CRC Screening</b> 33.1%–37.6% Non-Hispanic Black 12.0%–17.3% Other (including Hispanic)	<b>CRC Screening</b> 48.0%–52.9%	<b>CRC Screening</b> 43.3%–48.1%	<b>CRC Screening</b> Aged 50–59 = 59.2%–64.6% Aged 60+ = 35.4%–40.8%
Alemagno et al. [26]	212	68.6% African American	Not reported	63.3%	Range = 18–62 Mean = 36
<i>MI improves health screening, single arm</i>					
Costanza et al. [30]	45	Not reported	Not reported	0%	Aged 45–49 = 24.4% Aged 50–59 = 28.9% Aged 60+ = 46.6%
Foley et al. [25]	105	100% American Indian and Alaska Natives	0%	67.6%	Aged 20–30 = 30.5% Aged 31–40 = 35.2% Aged 41–50 = 27.6% Aged 50+ = 6.7%
<i>MI is not superior to an active control</i>					
Taplin et al. [31]	1765	3.8% Black/African American 0.8% Native American 4.0% Asian/Pacific Islander 2.3% Other	89%	0%	Aged 50–59 = 46.3% Aged 60–69 = 27.6% Aged 70–79 = 26.1%
Manne et al. [32]	412	8.6% Non-Caucasian	90.5%	39.8%	Mean = 47.9 SD = 9.0
<i>MI does not improve health screening, RCT</i>					
Chacko et al. [33]	376	67% African American 18% Hispanic 4% Other	11%	0%	Range = 16–21 Mean = 18.5 SD = 1.4
Menon et al. [38]	515	72.4% Black 9.9% Other	17.7%	69.7%	Mean = 58.1 SD = 7.9
Costanza et al. [35] <sup>a</sup>	Total sample = 2448 Sample offered MI = 97	Not reported	92%	43%	Mean = 61.4 Median = 60 Range = 52–77

<sup>a</sup> Statistics reported from entire sample.<sup>b</sup> See Valanis 2002 for demographic estimates based on a sample of 510.<sup>c</sup> Ranges of percentages across intervention groups.

incorporated MI were more likely to have a total cutaneous skin examination but not skin self-examination. Although this study yielded positive findings, the overall results remain mixed.

In addition, two single arm studies found that participants who received an MI intervention had increases in health screening rates, particularly HIV testing and mammography. Due to the studies' methodologies, there is high potential for bias (quality scores ranged from 1 to 2) and thus the results should be interpreted cautiously. Although these results are promising, in the absence of randomized clinical trials, we are unable to determine the true impact of MI in these studies.

Furthermore, two high quality studies reported that MI was significantly better than a minimal comparison group, yet did not provide additional benefit when compared to an active control group. These studies provide additional support for the efficacy of MI in this context. However, these results also call into question the

necessity and cost effectiveness of implementing MI interventions over more parsimonious treatment options.

Finally, three studies reported that MI did not have a statistically significant impact on health screening uptake. The first study, conducted by Menon and colleagues [34], found that a telephone based MI session did not improve colorectal cancer screening uptake among primary care patients. The odds ratio, however, approached statistical significance (OR = 1.6, 95% C.I. 0.9, 2.9). A second study, conducted by Costanza and colleagues [35], examined whether a telephone, computer-assisted counseling intervention could improve colorectal cancer screening rates. Within the intervention group, individuals who reported that they were not planning on getting screened for colorectal cancer were offered MI counseling. The results found that the intervention did not significantly impact colorectal cancer screening rates. Of note, of the 582 participants who received the computer-assisted

**Table 2**  
Study Outcomes.

Source	Study Design	Participants	Motivational Interviewing Intervention	Dose	Comparison Group(s)	Health Screening Outcome	Findings	Quality Rating
MI improves health screening, RCT Outlaw et al. [25]	RCT	African American men who have sex with men	<u>Field outreach ± MI</u> Face-to-face MI field outreach session	One face-to-face 30-min field outreach session	<u>Traditional field outreach</u> Field outreach session (e.g., education about HIV)	HIV counseling and testing	Participants in the field outreach + MI group were more likely to receive HIV counseling and testing (49%) compared to participants in the traditional field outreach group (20%) (chi squared = 17.94; P=.000)	6
Valanis et al. [27] Valanis et al. [39]	RCT	Women overdue for a mammogram and a pap smear	<u>Outreach intervention group</u> Mailed tailored letter addressing barriers to screening Participants who did not complete both screening tests after 6 months also received an MI telephone call <u>Inreach intervention group</u> Face-to-face MI session at the time of a primary care appointment <u>Combined intervention group</u> Both inreach and outreach interventions	<u>Outreach</u> One mailed letter One 15-min telephone call <u>Inreach</u> One 20-min, face-to-face session	<u>Control group</u> Usual Care	Mammogram and Pap Smear	<b>≤64 years old</b> Compared to the control group, participants in the outreach intervention group were more likely to receive both a mammogram and a pap smear at 14 months (OR = 4.24, 95% CI = 2.22–8.34) and 24 months (OR 2.53; 95% CI 1.40–4.63) There were no differences between the inreach intervention group and the control group There were no differences between the combined intervention group and the control group <b>≥65 years old</b> No significant differences between interventions groups and the control group	5
<sup>a</sup> Manne et al. [25]	RCT	First degree relatives of patients with melanoma who were non-adherent with skin cancer prevention behaviors	<u>Tailored intervention</u> Three tailored educational mailings and one tailored MI counseling call	One telephone call Average time = 30.2 minutes	<u>Generic intervention</u> Three generic educational mailings and a generic educational call	Total cutaneous skin examination by a health provider (TCE), Skin self-examination (SSE)	Compared to the generic intervention, participants in the tailored intervention group were 1.94 times more likely to have a total cutaneous skin examination (OR = 1.94; 95% C.I. 1.39,2.72) Participants in the tailored arm were not more likely to perform skin self-examination	5
Masson et al. [23]	RCT	Men enrolled in a methadone maintenance treatment program	<u>Intervention group</u> On site screening for HIV and hepatitis MI enhanced education and counseling Vaccinations and MI enhanced case-management	2 counseling sessions (pretest and posttest) 6 months of case management	<u>Control group</u> Non-MI pretest and posttest counseling HIV and Hepatitis testing Off-site referral for vaccine and hepatitis evaluation	Attendance of an HCV evaluation 286 participants required an HCV evaluation on based on serological testing	Participants in the intervention group were more likely to receive an HCV evaluation compared to participants in the control group (65.1% vs 37.2%, OR = 4.10; 95% CI = 2.35, 7.17)	5
Fortuna et al. [28]	RCT	Individuals overdue for CRC screening Women overdue for breast cancer screening	<u>Letter ± personal call</u> A mailed letter A telephone call that used MI principles	One telephone call	<u>Comparison group</u> <u>Letter</u> A mailed letter <u>Other intervention groups</u> <u>Letter ± Audiodial</u> A mailed letter Up to five automated telephone calls <u>Letter ± Audiodial ± prompt</u>	Mammography or CRC screening	Compared to a letter alone, the letter + personal call group was more effective at improving screening rates for breast cancer (17.8% v 27.5% AOR 2.2, 95% CI 1.2–4.0) and CRC	5

Table 2 (Continued)

Source	Study Design	Participants	Motivational Interviewing Intervention	Dose	Comparison Group(s)	Health Screening Outcome	Findings	Quality Rating
					A mailed letter Up to five automated calls Participants and physicians also received paper prompts at a scheduled appointment to discuss cancer screening		(12.2% vs. 21.5%; AOR 2.0, 95% CI 1.1–3.9) Participants in the letter + personal call group who received an MI call (reached) were more likely to receive a screening than those who were unable to be reached (30.9% v 20.2%, p = 0.05)	
Alemagno et al. [26]	RCT	Criminal justice involved clients	<u>Brief negotiation interview</u> MI based brief negotiation interviewing session using a “talking laptop” computer	One 20-min computerized intervention	<u>Control group</u> Written educational materials on HIV, STD, TB and hepatitis	HIV testing	Participants in the brief negotiation interview group (34.6%) were significantly more likely to have an HIV test than participants in the control group (13.6%) (chi-square = 8.4, df = 2, p = .004)	2
<i>MI improves health screening, single arm</i>								
Costanza et al. [30]	Single arm trial	Women overdue for a mammogram ≥27months	<u>Computer-assisted telephone interviewing with MI</u> Mailed educational booklet Telephone computer-assisted tailored counseling and MI session Assistance scheduling a mammogram	Not reported	None	Mammogram	Of the 45 participants, 26 (57.8%, 95% CI = 43.3, 72.0) of the participants received a mammogram	2
Foley et al. [25]	Single arm trial	Substance users in a residential treatment program	<u>Intervention</u> Group HIV prevention educational presentation Individual MI session	One 60-minute educational, group presentation One 30-minute face-to-face intervention	None	HIV testing	78% of participants (105/134) received HIV testing	1
<i>MI does not add additional benefit to active control</i>								
Taplin et al. [31]	RCT	Women who had not scheduled a recommended mammography	<u>Motivational call</u> MI telephone call	One telephone call Average time = 8.5 min	<u>Reminder Postcard</u> Postcard that reminded participants about the recommended mammography <u>Reminder Telephone Call</u> Telephone call that reminded participants about the mammography and assisted in scheduling the appointments	Mammogram	Participants in the motivational call group were more likely to receive a mammogram than participants in the reminder postcard group (OR = 1.8, 95% CI 1/5–2.2) Participants in the reminder telephone call group were more likely to receive a mammogram than participants in the reminder postcard group (OR = 1.9, 95% CI 1.5, 2.3) No statistical differences between the motivational interviewing telephone call group and the reminder call group	6
<sup>a</sup> Manne et al. [32]	RCT	Individuals who were overdue for a CRC screening and had a sibling	<u>Tailored print plus telephone counseling group</u> Mailed personal cover letter and tailored booklet	One telephone call Average time = 19 min	<u>Generic print group</u> Mailed cover letter and generic pamphlet about CRC screening <u>Tailored print group</u> Mailed personal cover letter	CRC screening	Participants in the tailored print plus telephone counseling group were significantly more likely to be screened	5

Table 2 (Continued)

Source	Study Design	Participants	Motivational Interviewing Intervention	Dose	Comparison Group(s)	Health Screening Outcome	Findings	Quality Rating
		diagnosed with CRC	MI telephone counseling session Follow up tailored newsletter		and tailored booklet about CRC screening One tailored follow up newsletter		than those in the generic print group (Wald Chi-Square = 4.40; $p = 0.036$ ) Participants in the tailored print group were more likely to be screened than those in the generic print group (Wald Chi-Square = 6.15; $p = 0.013$ ) No significant differences between the two tailored intervention groups	
<i>MI does not improve health screening, RCT</i>								
Chacko et al. [33]	RCT	Adolescent women attending a community-based, urban clinic that provided free reproductive health care	<u>Intervention ± standard care</u> MI intervention Clinical care and risk reduction counseling	One 30–50 minute baseline session One 30–50 min two week follow up session One 15-min six month follow up session	<u>Standard care</u> Clinical care and risk reduction counseling	STI screening	No significant differences between study groups	6
Menon et al. [34]	RCT	Primary care patients who had no family history of CRC and were non-adherent with CRC screening	<u>Motivational Interviewing</u> Telephone-based MI session	One telephone call Average time = 21.2 min	<u>Tailored Counseling</u> Tailored scripted telephone intervention <u>Control Group</u> Possible referral for a CRC screening	CRC screening	No significant differences between the MI group and the control group (OR = 1.6, 95% C.I. 0.9,2.9) Participants in the tailored counseling group were 2.2 times more likely to receive a CRC screening than participants in the control group (OR = 2.2; 95% C.I. 1.2, 4.00)	5
Costanza et al. [35]	RCT	Primary care patients who had not had a colonoscopy within the past 10 years	<u>Intervention</u> Mailed educational brochure on CRC and screening Computer-assisted counseling telephone call Participants who were not planning on getting tested (N = 97) were offered MI counseling	One telephone call Average time of MI component = 6 min	<u>Control group</u> Usual care	Colonoscopy, sigmoidoscopy, or fecal occult blood testing	There were no statistically significant differences between the intervention and control groups Of those participants who were offered MI, 19.5% changed their screening intentions (N = 19/97)	4

Acronym Key: RCT = Randomized Control/Clinical Trial; MI = Motivational Interview; CRC = Colorectal Cancer; STD = Sexually Transmitted Disease; TB = Tuberculosis; TCE = Total Cutaneous Skin Examination; SSE = Skin Self-Examination; HCV = Hepatitis C Virus; STI = Sexually Transmitted Infection.  
Note: <sup>a</sup> Article selected due to the authors' familiarity with the research.

counseling intervention, only 97 reported that they were not planning on getting screened for colorectal cancer and were thus eligible for MI counseling. Of the 97 participants who were offered MI counseling, 25 (25.7%) refused the additional counseling. Therefore, of the 582 participants in the intervention group, only 97 were even offered MI and only 72 accepted the counseling. Within that group of 97, 19 (19.5%) changed their intentions to get screened. Because MI was not offered to all of the participants, it is difficult to discern the exact impact that MI had on colorectal cancer screening in this context.

A third study, which received a quality rating of six, conducted by Chacko and colleagues [33] found that an MI intervention did

not significantly improve screening for sexually transmitted infections among women attending a reproductive clinic. Interestingly, this study was the only study included in the review that implemented MI to improve young adults'/adolescents' health screening behaviors. Moreover, it was the only study which examined the impact of MI on improving screenings for sexually transmitted infections. Future research is needed to determine whether age and/or outcome moderate the impact of MI intervention on health screening uptake.

Amongst the 13 studies included in systematic review, there was substantial variability in the mode of delivery of MI. Approximately half the studies implemented MI over the

telephone, while the other studies conducted the MI in person or via a computer. The mode of delivery of MI did not appear to impact the efficacy of the intervention. These results suggest that more parsimonious and cost-effective methods of delivery (e.g., telephone or computer) may be sufficient to produce behavior change with regard to health screening uptake.

There were several factors that limited our ability to draw definitive conclusions regarding the impact of MI on health screening uptake. Most notably, there was substantial variability in the operational definitions of MI. Some studies provided minimal details regarding the MI intervention while other studies published detailed implementation papers that clearly delineated the MI methods employed in the intervention [e.g.,36]. It is important that future research more clearly defines and describes the MI interventions and how they are being implemented within the study. Such details would allow for more accurate comparisons amongst studies and lay the foundation for future replication studies. Additionally, publishing the details of the intervention provides guidelines for practitioners to disseminate the interventions into standard clinical practice.

Moreover, the majority of the studies included in the systematic review implemented MI in conjunction with other active treatments, such as print materials. In the larger literature, MI is frequently used as an adjunct or a prelude to other empirically supported treatments (e.g., cognitive behavioral therapy, education, self-help manuals) [7]. In fact, it has been argued that combining MI with other treatments may enhance the impact of both interventions on behavioral change [7]. Although combination treatments are often efficacious, with regard to the systematic review, it is difficult to determine the exact impact that MI has on improving health screenings. Future dismantling studies are needed to better understand whether MI serves as a driving component of change in the intervention package. Furthermore, the combination of MI with other treatments poses difficulties in the assessment of treatment fidelity [37].

There are limitations to the systematic review that may have impacted the results. First, there is the potential for publication bias, which could have positively skewed the findings. It is commonly known that null results are often under published [38]. We did not seek the results of unpublished studies, and thus may have missed critical null results. Second, as was perviously discussed, the majority of the studies included in the systematic review implemented MI as an adjunct to a larger treatment. It is possible that studies did not report the MI component of the intervention in the abstract, and thus were missed by our search strategy. In fact, as was previously reported, we were aware of two articles that incorporated MI yet were missed by our search strategy. Third, it is possible that our inclusion criteria were too specific and thus we may have missed relevant articles. In particular, our review search was limited to three databases (PubMed, PsycINFO and CINAHL) and excluded publications that were not in English. Furthermore, only full articles were reviewed and therefore relevant publications (e.g., dissertations, presentations) may have been missed. Future research could conduct a more exhaustive review in order to expand upon the results. Fourth, due to the limited number of articles and the heterogeneity amongst the studies, a formal meta-analysis was not conducted. As this area of research expands, a future study should conduct a meta-analysis to better understand the size of the effect that MI has on improving health screening uptake.

#### 4.2. Conclusions

Overall, the results of the systematic review were mixed. Of the 13 studies, 6 found MI more efficacious than a control, 2 found MI more efficacious than a weak control yet equivalent to an active

control, and 3 found MI was not significantly better than a control. Two single arm studies reported improvements in health screening rates following an MI intervention. While MI shows promise for improving health screening uptake; it may not be the most parsimonious intervention option. Unfortunately, given the mixed results, the wide variability amongst the studies and the limited number of randomized clinical trials, it is difficult to discern the exact impact that MI has on health screening uptake.

#### 4.3. Practical implications

Future, more detailed, research is needed to better understand the impact that MI can have on health screenings in this context. Furthermore, implementation papers are needed in order to better explain how MI is defined and implemented in each study. This future research would provide further support for the integration of MI into standard clinical practice to improve health screening uptake among adults.

#### Conflicts of interest

The authors do not have any conflicts of interest.

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