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Controlled Interventions to Reduce Burnout in Physicians
A Systematic Review and Meta-analysis

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IMPORTANCE Burnout is prevalent in physicians and can have a negative influence on performance, career continuation, and patient care. Existing evidence does not allow clear recommendations for the management of burnout in physicians.

OBJECTIVE To evaluate the effectiveness of interventions to reduce burnout in physicians and whether different types of interventions (physician-directed or organization-directed interventions), physician characteristics (length of experience), and health care setting characteristics (primary or secondary care) were associated with improved effects.

DATA SOURCES MEDLINE, Embase, PsycINFO, CINAHL, and Cochrane Register of Controlled Trials were searched from inception to May 31, 2016. The reference lists of eligible studies and other relevant systematic reviews were hand searched.

STUDY SELECTION Randomized clinical trials and controlled before-after studies of interventions targeting burnout in physicians.

DATA EXTRACTION AND SYNTHESIS Two independent reviewers extracted data and assessed the risk of bias. The main meta-analysis was followed by a number of prespecified subgroup and sensitivity analyses. All analyses were performed using random-effects models and heterogeneity was quantified.

MAIN OUTCOMES AND MEASURES The core outcome was burnout scores focused on emotional exhaustion, reported as standardized mean differences and their 95% confidence intervals.

RESULTS Twenty independent comparisons from 19 studies were included in the meta-analysis (n = 1550 physicians; mean [SD] age, 40.3 [9.5] years; 49% male). Interventions were associated with small significant reductions in burnout (standardized mean difference [SMD] = −0.29; 95% CI, −0.42 to −0.16; equal to a drop of 3 points on the emotional exhaustion domain of the Maslach Burnout Inventory above change in the controls). Subgroup analyses suggested significantly improved effects for organization-directed interventions (SMD = −0.45; 95% CI, −0.62 to −0.28) compared with physician-directed interventions (SMD = −0.18; 95% CI, −0.32 to −0.03). Interventions delivered in experienced physicians and in primary care were associated with higher effects compared with interventions delivered in inexperienced physicians and in secondary care, but these differences were not significant. The results were not influenced by the risk of bias ratings.

CONCLUSIONS AND RELEVANCE Evidence from this meta-analysis suggests that recent intervention programs for burnout in physicians were associated with small benefits that may be boosted by adoption of organization-directed approaches. This finding provides support for the view that burnout is a problem of the whole health care organization, rather than individuals.

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Editorial
Supplemental content

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Burnout is a syndrome consisting of emotional exhaustion, depersonalization, and a diminished sense of personal accomplishment, which is primarily driven by workplace stressors.[1(pp191-218)2] Burnout is a major concern for physicians. Nearly half of practicing physicians in the United States experience burnout at some point in their career.[3] Although there are substantial differences by specialty, physicians at the front line of care report the highest rates of burnout.[4]

Burnout has serious negative consequences for physicians, the health care system, and for patient outcomes. Burnout in physicians has been linked with lower work satisfaction, disrupted personal relationships, substance misuse, depression, and suicide.[5,6] Within health care organizations, burnout is related to reduced productivity, high job turnover, and early retirement.[7-9] Importantly, burnout can result in an increase in medical errors, reduced quality of patient care, and lower patient satisfaction.[10-15] It is not surprising, therefore, that wellness of physicians is increasingly proposed as a quality indicator in health care delivery.[16]

Leading drivers of burnout include excessive workload, imbalance between job demands and skills, a lack of job control, and prolonged work stress.[17] Recently, there has been a shift from viewing burnout as an individual problem to a problem of the health care organization as a whole, rooted in issues related to working environment and organizational culture.[18] It has been suggested that reducing risk of burnout in physicians requires change in organizations, as well as support for individual physicians.[19]

Interventions for burnout can be classified into 2 main categories, physician-directed interventions targeting individuals and organization-directed interventions targeting the working environment.[20,21] Physician-directed interventions typically involve mindfulness techniques or cognitive behavioral techniques to enhance job competence and improve communication skills and personal coping strategies. Organization-directed interventions can involve simple changes in schedule and reductions in the intensity of workload or more ambitious changes to the operation of practices and whole health care organizations. These usually involve improved teamwork, changes in work evaluation, supervision to reduce job demand and enhance job control, and increasing the level of participation in decision making.

We conducted a systematic review and meta-analysis of studies that evaluated interventions to reduce burnout in physicians. We decided to focus on burnout scores as the main outcome of this review because burnout is the best-recognized serious negative consequence of work stress in physicians[18,22] and the most commonly reported, and consistently measured, outcome of work stress interventions.[20,21,23] Moreover, by focusing on burnout, we established a level of homogeneity in terms of outcomes that allowed us to test our aims meta-analytically.

Our first objective was to assess the effectiveness of interventions in reducing burnout. Second, we examined what types of interventions are the most effective (organization directed, physician directed). Third, we examined whether there are any differences in the effect of interventions in different health care settings (primary care, secondary or intensive care) and in physicians with different levels of working experience. Our rationale was that physicians working in different organizational settings or physicians with different levels of experience might have diverse needs and might respond differently to burnout interventions.

Key Points

Question Are interventions for reducing burnout in physicians effective?

Findings This meta-analysis of 20 controlled interventions on 1550 physicians found that existing interventions were associated with small and significant reductions in burnout. The strongest evidence for effectiveness was found for organization-directed interventions, but these interventions were rare.

Meaning More effective models of interventions are needed to mitigate risk for burnout in physicians. Such models could be organization-directed approaches that promote healthy individual-organization relationships.

Methods

The reporting of the review adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (eTable 1 in the Supplement).[24] The protocol is included in eMethods 1 in the Supplement.

Eligibility Criteria

The study population comprised physicians of any specialty in the primary, secondary, or intensive care setting including residents and fellows. Studies based on a mix of physicians and other health care professionals were included in the review if the physicians made up at least 70% of the sample.

Eligible interventions were any intervention designed to relieve stress and/or improve performance of physicians and reported burnout outcomes including physician-directed interventions and organization-directed interventions. Physician-directed interventions focused on individuals (eg, cognitive behavioral therapies, mindfulness-based stress reduction techniques, educational programs for improving communication skills) whereas organization-directed interventions introduced changes in the resources, the working environment, and/or work tasks to decrease stress (eg, changes in the intensity and/or schedule of the workload or deeper improvements in the operation of health care organizations and teamwork).

Eligible comparisons included any type of control (eg, waiting list or no intervention). Outcome was burnout measured using validated tools such as the Maslach Burnout Inventory (MBI)[1] or other validated measures of burnout. Eligible study designs were quantitative intervention designs described in the Cochrane handbook including randomized clinical trials, nonrandomized trials, controlled before-after studies, and interrupted time series. Context was any health care setting including primary care and secondary care.

Exclusion Criteria

Interventional studies not reporting data on burnout outcomes but providing data on general stress, well-being, or job satisfaction were excluded, as was gray literature.

Search Strategy and Data Sources

Five electronic bibliographic databases were searched from inception until May 31, 2016: MEDLINE, Embase, CINAHL, Cochrane Register of Controlled Trials, and PsycINFO. The search strategy included combinations of 3 key blocks of terms (burnout; physicians; interventions) using medical subject headings (MESH terms) and text words (eMethods 2 in the Supplement). Searches were supplemented by hand searches of the reference lists of eligible studies and systematic reviews.

Study Selection

The results of the searches were exported in Endnote and duplicates were removed. Study selection was completed in 2 stages. First, the titles and abstracts of the studies were screened and subsequently the full texts of relevant studies were accessed and further screened against the eligibility criteria. The title and abstract screening was undertaken by M. P., whereas 2 independent reviewers were involved in full-text screening. Interrater reliability was high ($\kappa = 0.96$). Disagreements were resolved through discussions.

Data Extraction

An Excel data extraction form was developed and initially piloted in 5 randomly selected studies. Quantitative data for meta-analysis were extracted on a separate extraction sheet. Authors were contacted when data were missing or incomplete. The following descriptive information was extracted from the studies:

- Study: research design, method of recruitment, and content of control
- Participants: sample size, age, sex, setting and/or specialty, years of work experience
- Intervention: content, delivery format, intensity, follow-up time points
- Outcomes: scores in burnout including emotional exhaustion, depersonalization, and professional accomplishment.

Risk of Bias Assessment

The critical appraisal of the studies was performed using the Effective Practice and Organisation of Care (EPOC) risk of bias tool.[25] It was chosen because it is appropriate for use across all types of intervention designs described in the Cochrane handbook. The EPOC tool contains 9 standardized criteria scored on a 3-point scale, corresponding to low, unclear, and high risk.

Data Analysis

Standardized mean differences (SMDs) and associated confidence intervals for the burnout outcomes of all the studies were calculated in Comprehensive Meta-Analysis.[26] The pooled SMDs and the forest plots were computed using the metaan command in Stata 14.[27] The main meta-analysis evaluated the effectiveness of the interventions in reducing burnout. The MBI measure for burnout provides ratings in 3 domains (emotional exhaustion, depersonalization, and personal accomplishment). It is not recommended that they be combined.[1] In line with previous meta-analyses, we used only the emotional exhaustion domain of MBI in the analyses.[23] Emotional exhaustion is considered the most central aspect of burnout (some studies only use this domain), and other unidimensional measures of burnout focus on emotional exhaustion.[23,28] To ease the interpretation of the results we "back-transformed" the pooled SMD to a mean difference for the emotional exhaustion subscale, under certain assumptions. When data were available for more than 1 follow-up assessment point, the short-term assessment points were inserted in the main analysis. Three prespecified subgroup analyses[29] were carried out:

1. *Type of interventions*—we tested the effectiveness of physician-directed and organization-directed interventions.
2. *Working experience of physicians*—we examined the differential treatment effects across studies that recruited physicians with extensive working experience (mean of ≥5 years) and studies that recruited physicians with low experience (mean of <5 years). All studies classified into the low-experience category explicitly reported in the Methods that they recruited junior physicians.
3. *Health care setting*—we tested the effects of interventions separately in physicians based in primary care and in secondary care.

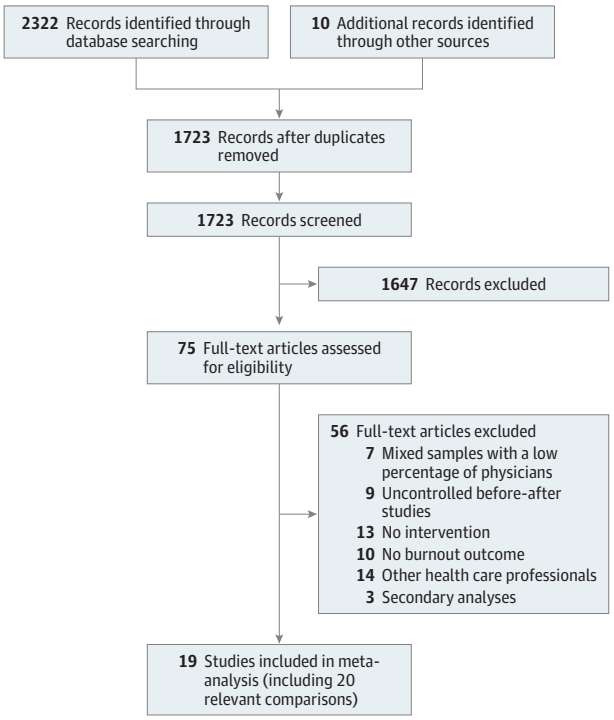
Two sensitivity analyses were performed. We examined the effects of interventions on the other 2 domains of MBI (depersonalization and personal accomplishment). We also examined whether effects were robust when only studies with low risk of bias scores were retained in the analyses.

Heterogeneity was assessed using the I^2 statistic. Conventionally, I^2 values of 25%, 50%, and 75% indicate low, moderate, and high heterogeneity.[30] All analyses were conducted using a random-effects model, even if I^2 was low. Random-effects models are more conservative and have better properties in the presence of any heterogeneity.[31,32] The Cohen Q test of between-group variance was used to test whether the effectiveness of burnout interventions is significantly different across subgroups. Cluster randomized clinical trials were identified and the precision of analyses adjusted using a sample size/variation inflation method, assuming an intraclass correlation of 0.02. Provided that we identified 10 or more studies,[33] we aimed to use funnel plots and the Egger test to assess small-sample bias (an indicator of possible publication bias).[34] Funnel plots were constructed using the metafunnel command,[35] and the Egger test was computed using the metabias command.[36]

Results

As shown in **Figure 1**, the search strategy yielded 2322 articles. Following the removal of duplicates, 1723 articles were retained for title and abstract screening. Of these, 75 were relevant for full-text screening and 19 studies were included in the review.[37-55] One study included a lower percentage of

Figure 1. PRISMA Flowchart



Flowchart of the inclusion of studies in the review.

physicians (67%), but we retained it in the analyses to maximize the evidence base.[39]

Characteristics of Studies and Physicians

The **Table** presents the characteristics of the 19 studies (including 20 independent comparisons on 1550 physicians; mean [SD] age, 40.3 [9.5] years). Eight studies were conducted in the United States (42%), 4 in Europe, 3 in Australia, 2 in Canada, 1 in Argentina, and 1 in Israel. An equal proportion of men and women were recruited in the majority of studies.

Seven studies recruited physicians working in primary care (mostly labeled "general practitioners"), 10 studies recruited physicians in secondary care (eg, physicians in intensive care units, oncologists, and surgeons), and 2 studies recruited a mixed sample of physicians through their registration in national medical associations. Across all interventions, the main eligibility criteria were being a physician (working in a specific setting in most cases) and willingness to take part in the study. None of the studies specifically targeted physicians with certain severity levels of burnout. The majority of studies (n = 12 [67%]) were based on experienced physicians (mean working experience of ≥5 years) whereas 7 studies were based on recently qualified physicians (mean working experience of <5 years). With the exception of 1 study,[37] all used the MBI to assess the severity of burnout (eTable 2 in the Supplement).

Characteristics of Interventions

Interventions varied considerably in their characteristics including content, duration/intensity, and length of post-intervention assessment points (see Table). The majority (n = 12 [60%]) were physician-directed interventions that comprised mindfulness-based stress reduction techniques, educational interventions targeting physicians' self-confidence and communication skills, exercise, or a combination of these features.

Within the category of organization-directed interventions, 5 studies evaluated simple workload interventions that focused on rescheduling hourly shifts and reducing workload. Only 3 studies tested more extensive organization-directed interventions incorporating discussion meetings to enhance teamwork and leadership, structural changes, and elements of physician interventions such as communication skills training and mindfulness.

The duration of the interventions ranged from 2 weeks to 9 months. Follow-up assessment points ranged from 1 day to 18 months after the intervention. All interventions were delivered in face-to-face format.

Risk of Bias Characteristics

The results of the risk of bias assessment are presented in eFigure 1 in the Supplement. Eighteen comparisons were randomized clinical trials (95%) whereas 2 were controlled before-and-after studies. Fifteen comparisons (75%) fulfilled 6 of the 9 risk of bias criteria (a higher score indicates lower vulnerability to bias). Three comparisons fulfilled 8 or 9 criteria (17%) while 5 fulfilled 4 or fewer criteria (25%); most moderately accounted for the risk of bias criteria.

Main Meta-Analysis: Effectiveness of Interventions in Reducing Burnout

Interventions were associated with small, significant reductions in burnout (SMD = −0.29; 95% CI, −0.42 to −0.16; I^2 = 30%; 95% CI, 0 to 60%) (**Figure 2**). The back-transformed emotional exhaustion score for the intervention group was 15.1 (95% CI, 13.9 to 16.5), compared with a control group score of 17.9 and assuming a standard deviation of 8.97 for the effect.

Subgroup Analyses

Types of Interventions

Physician-directed interventions were associated with small significant reductions in burnout (SMD = −0.18; 95% CI, −0.32 to −0.03; I^2 = 11%; 95% CI, 0 to 49%; back-transformed emotional exhaustion score = 16.2; 95% CI, 14.7 to 17.3 compared with a control group score of 17.9) whereas organization-directed interventions were associated with medium significant reductions in burnout (SMD = −0.45; 95% CI, −0.62 to −0.28; I^2 = 8%; 95% CI, 0 to 60%; back-transformed emotional exhaustion score = 13.9; 95% CI, 12.4 to 14.7 compared with a control group score of 17.9) (**Figure 3**). The effects of organization-directed interventions were significantly larger than the effects of physician-directed interventions (Cohen Q = 4.15, P = .04).

Working Experience

The pooled effect of interventions on burnout scores was medium and significant across studies mainly based on experienced physicians (SMD = −0.37; 95% CI, −0.58 to −0.16;

Table. Characteristics of Studies and Interventions Included in This Review

Source	Country	Recruitment and Eligibility	Health Care Setting	Male Sex, Proportion (%)	Age, Mean, y	Time in Practice, y	Research Design	Intervention	Control	Follow-up Point
Ali et al,[37] 2011	United States	Physicians with various specialties working in intensive care units	Intensive care	24/45 (54)	41	Mean, 8	Cluster RCT	Organization-directed (focused on workload or schedule): Two intensivist staffing schedules were compared: continuous and interrupted (rotations every 2 wk) for 14 mo.	Continuous schedule	9 mo
Amutio et al,[38] 2015	Spain	Physicians with various specialties registered in a national medical organization	Mixed sample of physicians	18/42 (43)	43	Mean, 9	RCT	Physician-directed: A 2-mo mindfulness-based stress reduction program that involved a weekly Powerpoint presentation of stressful topics related to the medical profession (eg, healing with suffering), a weekly 45-min mindfulness exercise, a weekly 60-min group reflection about the weekly topic, and the mindfulness exercise	Waiting list	1 mo
Asuero et al,[39] 2014	Spain	Physicians and allied health professionals in primary care	Primary care	6/68 (8)	47	Mean, 10	RCT	Physician-directed: 2 mo (8 sessions of 2.5 h/wk plus a 1-d session of 8 h) of contemplation-meditation exercises such as mindfulness meditation, in which participants focus on the present-moment experience and contemplate nonjudgmentally bodily sensations, breathing, sounds, and thoughts	Waiting list	2 mo
Bragard et al,[40] 2010	Belgium	Internal medicine residents with an interest in psychological training	University-based hospital	34/96 (35)	28	Mean, 3	RCT	Physician-directed: a 30-h communication skills training and a 10-h stress management skills training in small groups (≤7 participants)	Waiting list	2 mo
Butow et al,[42] 2008	Australia	Oncologists from 6 tertiary care hospitals in 6 Australian cities that incorporated oncology outpatient clinics	Teaching hospitals, oncology unit	15/30 (50)	44	Mean, 16	RCT	Physician-directed: 1.5-d intensive face-to-face workshop with 3-6 participants incorporating presentation of principles, a DVD modeling ideal behavior, and role play practice, followed by 4 1.5-h videoconferences at monthly intervals incorporating role play of physician-generated scenarios	Waiting list	3 and 6 mo
Butow et al,[41] 2015	Australia	Oncologists working in major cancer centers involved in the treatment of patients with early breast cancer	Cancer centers or clinics	26/62 (42)	45	>6	RCT	Physician-directed: A 7-h interactive face-to-face workshop training with a follow-up telephone call 1 mo later. The elements of the training workshop were evidence based and used accepted adult learning principles.	No intervention	Postinter-vention
Garland et al,[43] 2012	Canada	Physicians in ICUs	ICUs	27/34 (80)	Range, 41-60	Most >10	Crossover RCT	Organization-directed (focused on workload): shift work staffing in which there was 24/7 intensivist presence. The same pool of intensivists supplied day shift and night shift coverage. In any given week, a single intensivist was responsible for all 7 day shifts (8 AM-5:30 PM, 8 AM-3 PM on weekends), whereas 2 different intensivists alternated the 7 night shifts.	Standard staffing: 1 intensivist staffed an ICU for 7 d, was present during daytime, and took calls from home at night, returning to ICU as deemed necessary.	Postinter-vention
Gunasingam et al,[44] 2015	Australia	Postgraduate year 1 physicians in a single hospital	Teaching hospital	16/31 (52)	Range, 25-30 y	Mean, 1 y	RCT	Physician-directed: 3 1-h debriefing sessions and a focus group that explored themes around work-related stressors, coping mechanisms, and potential strategies to improve junior medical officer well-being	No intervention	2 wk
Linzer et al,[45] 2015	United States	Physicians working in 34 primary care clinics	Primary care	80/166 (48)	46	Mean, 12	Cluster RCT	Organization-directed (focused on communication, teamwork, and quality improvement): targeted quality improvement projects, improved communication, and changes in workflow	No intervention	12-18 mo
Lucas et al,[46] 2012	United States	General medicine inpatient service of a 500-bed public teaching hospital	General medicine service of hospital	32/62 (52)	38	Mean, 4	Cluster RCT	Organization-directed (focused on workload or schedule): assignment to random sequences of 2-wk shift rotations	4-wk rotations	1 mo

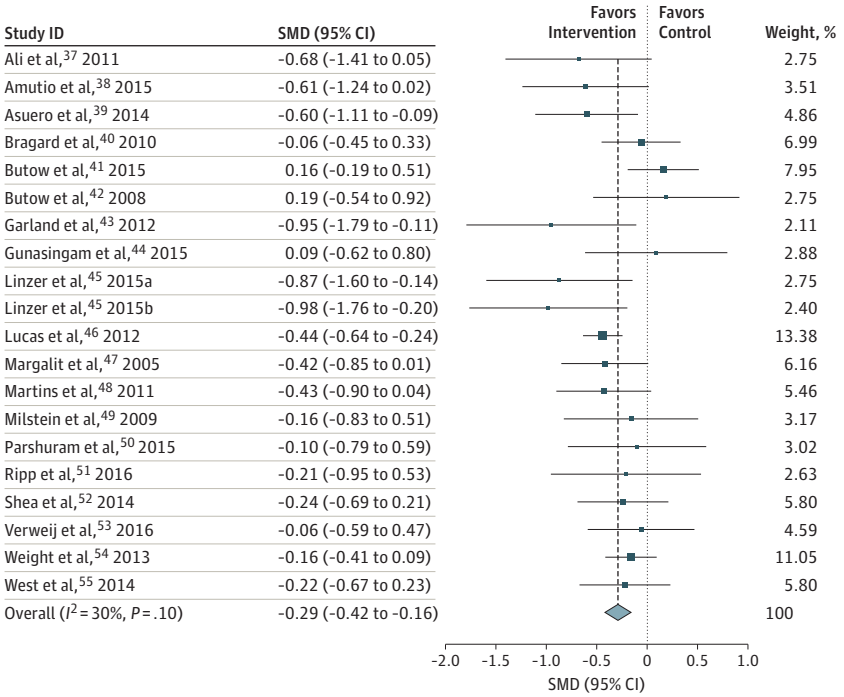
(continued)

Table. Characteristics of Studies and Interventions Included in This Review (continued)

Source	Country	Recruitment and Eligibility	Health Care Setting	Male Sex, Proportion (%)	Age, Mean, y	Time in Practice, y	Research Design	Intervention	Control	Follow-up Point
Margalit et al,[47] 2005	Israel	General practitioners randomly selected	Primary care	22/44 (50)	NR	Mean, 9	RCT	Physician-directed: 1 weekly 4-6 h workshop for a total of 12 wk. Interactive teaching intervention aiming to impart the knowledge, attitudes, and skills needed for adapting to the task of a physician in a busy community clinic	Noninteractive group	6 mo
Martins et al,[48] 2011	Argentina	Pediatric residents in a tertiary hospital	Tertiary hospital	14/74 (19)	27	Mostly experi-enced (>5 y)	RCT	Physician-directed: 2 2.5-h self-care workshops coordinated by mental health professionals, who addressed aspects of burnout syndrome such as identification of risk factors, coping behaviors, preventive behaviors, and self-care	No intervention	2 mo
Milstein et al,[49] 2009	United States	Pediatric department physicians	Primary care	7/15 (47)	NR	Mean, 11	RCT	Physician-directed: 45-min stress reduction intervention in which one reflects on the background of the situation that may have generated stress professionally, examines one's affect, analyzes the most troublesome aspects of the situation, reflects on how one handled the situation, and provides oneself empathy (supportive comments)	No intervention	3 mo
Parshuram et al,[50] 2015	Canada	Residents in anesthesia, surgery, and emergency medicine training programs who performed overnight duty	ICUs	25/47 (53)	NR	Range, 1-3	RCT	Organization-directed (focused on workload or schedule): Residents in 2 university-affiliated ICUs were randomly assigned (in 2-mo rotation blocks from January to June 2009) to in-house overnight schedules of 12 h.	16- and 24-h overnight schedules	Postinter-vention
Ripp et al,[51] 2015	United States	First-year residents in an internal medicine unit	Internal medicine residency program	20/39 (51)	NR	Mean, 1	RCT	Physician-directed: 18 1-hour bimonthly groups who met regularly with trained discussion group leaders to discuss topics related to stress, balance, and job satisfaction	Lunch vouchers	Postinter-vention
Shea et al,[52] 2014	United States	Graduate internal medicine interns in the oncology department of a hospital	Internal medicine service of hospital	59/106 (56)	28	Range, 1-2	RCT	Organization-directed (focused on workload or schedule): a 5-h period of protected time in which interns were expected to sleep (12:30 AM to 5:30 AM) for 4 wk	No intervention	Postinter-vention
Verweij et al,[53] 2016	Netherlands	General practitioners affiliated with Dutch training hospitals	Primary care	28/43 (65)	55	Mean, 24	Controlled before-after study	Physician-directed: 8 weekly sessions each lasting 2.5 h, and a 1-d silent retreat between the sixth and seventh session focused on mindfulness. Participants were encouraged to focus their attention on the present moment and to observe their own thoughts, feelings, and behavior in a nonjudgmental way. Some of the themes discussed were awareness of pleasant or unpleasant sensations, feelings, or thoughts; perceptual biases and filters; burnout; boundaries or conflict management; and self-care.	Waiting list	Post inter-vention
Weight et al,[54] 2013	United States	Residents and fellows at Mayo Clinic in Rochester, New York	Secondary care (various specialties)	368/628 (59)	31	Low experience (59% <3 y)	Controlled before-after study	Physician-directed: 12-wk, self-directed and team-based incentivized exercise program including self-reported exercise and gym attendance. Participants were encouraged to form teams of 5 for accountability and mutual commitment to exercise. Individual and team points were calculated and emailed to participants weekly.	No intervention	Postinter-vention
West et al,[55] 2014	United States	Practicing physicians in the Department of Medicine at the Mayo Clinic in Rochester, New York	Department of General Medicine	49/74 (65)	NR	Mean, 8	RCT	Organization-directed (components from physician-directed interventions): 19 biweekly facilitated discussion groups incorporating elements of mindfulness, reflection, shared experience, and small-group learning for 9 mo. Protected time (1 h of paid time every other week) for participants was provided by the institution.	No intervention	3 and 12 mo

Abbreviations: ICU, intensive care unit; NR, not reported; RCT, randomized clinical trial.

Figure 2. Forest Plot of the Effects of Interventions on Burnout Scores



Meta-analysis of individual study and pooled effects. Each line represents 1 study in the meta-analysis, plotted according to the standardized mean difference (SMD; roughly the difference between the mean score of participants in the intervention group and the mean score of participants in the control group). The squares show the SMD for each study, and the diamond represents the pooled SMD. Weights are from random-effects model.

I^2 = 42%; 95% CI, 0 to 70%; back-transformed emotional exhaustion score = 14.6; 95% CI, 12.7 to 16.5 compared with a control group score of 17.9) and small and significant across studies on physicians with limited experience (SMD = −0.27; 95% CI, −0.40 to −0.14; I^2 = 0%; 95% CI, 0 to 75%; back-transformed emotional exhaustion score = 15.5; 95% CI, 13.8 to 16.9 compared with a control group score of 17.9) (eFigure 2 in the Supplement). This group difference was nonsignificant (Q = 0.92, P = .34).

Health Care Setting

Interventions in primary care were associated with small to medium reductions in burnout (SMD = −0.39; 95% CI, −0.59 to −0.19; I^2 = 4%; 95% CI, 0 to 69%; back-transformed emotional exhaustion score = 14.4; 95% CI, 12.6 to 16.2 compared with a control group score of 17.9). Interventions in secondary care were associated with small significant reductions in burnout (SMD = −0.24; 95% CI, −0.41 to −0.07; I^2 = 41%; 95% CI, 0 to 65%; back-transformed emotional exhaustion score = 15.7; 95% CI, 13.9 to 17.4 compared with a control group score of 17.9) (eFigure 3 in the Supplement). This difference was nonsignificant (Q = 0.51, P = .48).

Sensitivity Analyses

The treatment effect derived by studies at lower risk of bias (ie, scoring low on 6 of the 9 risk of bias criteria) was similar to the overall effects of the main analysis (SMD = −0.32; 95% CI, −0.49 to −0.14; I^2 = 42%; 95% CI, 0 to 70%) (eFigure 4 in the Supplement).

Interventions were associated with very small significant reductions in depersonalization (SMD = −0.21; 95% CI, −0.35 to −0.06; I^2 = 33%; 95% CI, 0 to 68%) (eFigure 5 in the Supplement) and small improvements in personal accomplishment (SMD = 0.30; 95% CI, 0.15 to 0.45; I^2 = 0; 95% CI, 0 to 58%) (eFigure 6 in the Supplement). The subgroup analyses in these 2 domains showed similar results but were based on a smaller number of studies (eTable 3 in the Supplement).

Small-Study Bias

We found no evidence of funnel plot asymmetry, which might indicate publication bias for the main, or subgroup analyses (Egger test P = .11 for main analysis) (**Figure 4**).

Discussion

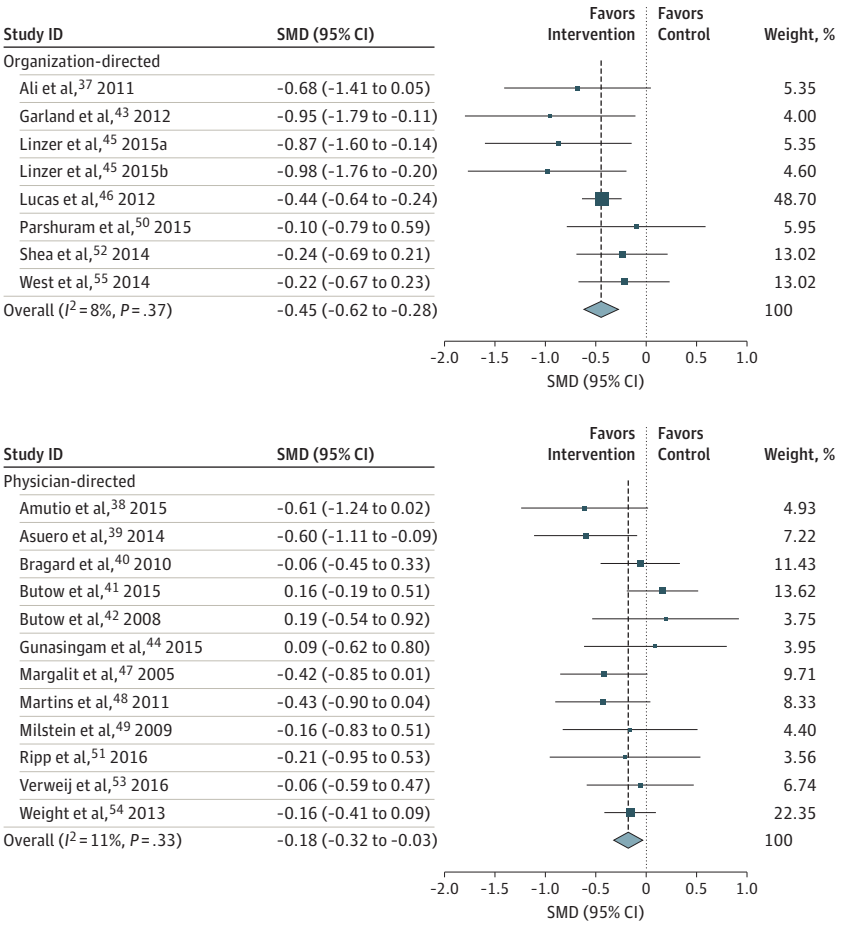
Summary of Main Findings

This meta-analysis showed that interventions for physicians were associated with small significant reductions in burnout. Organization-directed interventions were associated with higher treatment effects compared with physician-directed interventions. Interventions targeting experienced physicians and delivered in primary care showed evidence of greater effectiveness compared with interventions targeting less experienced physicians and delivered in secondary care, but these group differences were nonsignificant.

Strengths and Limitations

This is a comprehensive meta-analysis of controlled interventions aimed at reducing physician burnout. The 2 greatest threats to the validity of meta-analysis are heterogeneity and publication bias. However, the biggest strength of this work

Figure 3. Forest Plot of the Effects of Different Types of Interventions on Burnout Scores



Subgroup analysis of individual study and pooled effects of physician-directed and organization-directed interventions on burnout scores. Each line represents 1 study in the meta-analysis, plotted according to the standardized mean difference (SMD). The squares show the SMD for each study, and the diamond represents the pooled SMD. Weights are from random-effects model.

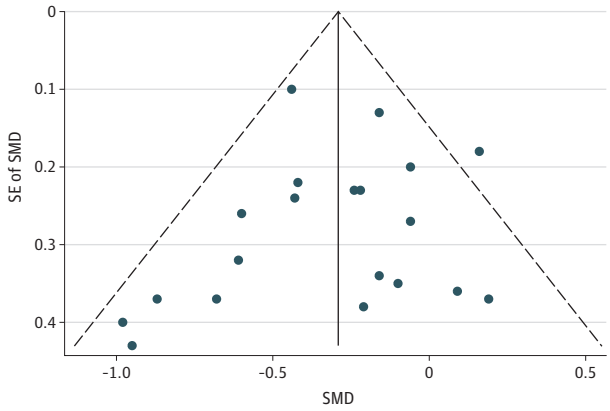
is the large number of identified and meta-analyzed controlled comparisons (20, when approximately 11.5% of all meta-analyses include ≥10 studies), which allows us to reliably estimate and model heterogeneity levels.[57] In addition, the size of the meta-analysis allowed us to assess publication bias with adequate power.[33] Although publication bias tests are rarely conclusive, we did not observe any bias indications in the plot or test.

The included studies differed significantly in terms of content of interventions, study design and/or quality, and length of follow-up that limit the extent to which broad conclusions can be drawn about the overall effectiveness of physician interventions. However, estimates of heterogeneity in the pooled analyses were low to moderate by conventional thresholds and random-effects models were applied in all analyses.[58] Heterogeneity was further addressed by conducting prespecified subgroup analyses (within the limits of power).[59] While this is a useful approach for producing guidance to design and deliver the most effective interventions, subgroup analyses should be interpreted cautiously because other, uncontrolled differences between studies might account for the results.[60,61]

Comparison With Previous Systematic Reviews

Three existing systematic reviews have examined the effectiveness of work stress interventions in health care professionals, with only 1 of these specifically focused on physicians.[21,62,63] Our findings regarding the overall effectiveness of burnout interventions and the increased effectiveness of organizational interventions are in agreement with the most recent meta-analysis on physician burnout.[63] In comparison, we narrowed our attention to controlled interventions and we undertook additional evidence-based prespecified subgroup analyses to examine whether the characteristics of interventions, physicians, and health care settings influenced the overall effect of burnout interventions. This decision was based on the recognition that controlled interventions offer the best opportunity to reach rigorous conclusions about the effectiveness of the tested interventions and that intervention studies on physician burnout are highly heterogeneous. This approach enabled us to draw informative conclusions regarding the effectiveness of burnout interventions among physicians that take into account the influence of the distinct features of interventions, physicians, and health care settings.

Figure 4. Funnel Plot of Standardized Mean Differences (SMDs) vs Standard Error for Burnout Scores



Funnel plot with pseudo 95% confidence intervals. The outer lines indicate the triangular region within which 95% of studies are expected to lie in the absence of both biases and heterogeneity. The funnel plot shows no substantial asymmetry (Egger regression intercept −0.28, SE = 0.16, P = .11).[56]

Implications for Researchers, Clinicians, and Policymakers

Even though many studies have examined risk factors for burnout in physicians, relatively few intervention programs have been developed and evaluated. Our main finding is that the treatment effects were significant but small, equal to a 3-point reduction in the emotional exhaustion domain of the MBI. At present, the low quality of the research evidence does not allow firm practical recommendations, but we offer some insights for research and clinical directions.

Organization-directed interventions were more likely to lead to reductions in burnout, but there were large variations in terms of actual approaches, intervention ingredients, and intensity. Those that combined several elements such as structural changes, fostering communication between members of the health care team, and cultivating a sense of teamwork and job control tended to be the most effective in reducing burnout.[45] However, such intense organization-directed interventions were rare and were not evaluated widely. The majority of organization-directed interventions that we included in the analyses introduced simple reductions in the workload or schedule changes. Concerns about implementation and delivery costs of organization-directed interventions, especially if they involve complex and major health care system changes, might explain their scarcity.[20,64] A recent example promoting healthy individual-organization relationships is the Listen-Act-Develop model implemented in Mayo Clinic.[65] Large-scale cluster-randomized trials of such programs at the institutional or even at the national level that emphasize organizational culture by creating a safe space for staff to acknowledge and decrease stress are possibly an optimal framework for mitigating burnout.

Physician-directed interventions led to very small significant reductions in burnout. We found no evidence that the content (eg, mindfulness, communicational, educational components) or intensity of these interventions might increase the derived benefits based on our critical review. This finding, in combination with the larger effects of organization-directed interventions, supports the argument that burnout is rooted in the organizational coherence of the health care system.[19,66] If burnout is a problem of whole health care systems, it is less likely to be effectively minimized by solely intervening at the individual level. It requires an organization-embedded approach.[19] Moreover, physicians expected to deal with burnout individually and remotely from their practicing organization might view physician-directed interventions as a personal responsibility (or blame themselves for being less "resilient") rather than as a shared resource to create a flourishing health care environment.[65,67] There is some evidence that elements of the physician-directed interventions (eg, mindfulness) are effective when supported by organizational approaches.[23,55] However, other unexamined factors at the process of the intervention delivery or at the participant level might account for the observed differences in the effectiveness of organization-directed and physician-directed interventions. Research programs to understand the best context for the delivery, evaluation, and implementation of burnout interventions are required.[68-70]

Physicians based in different health care settings or at different stages of their career might face unique challenges and have different needs. We found smaller benefits for recently qualified and secondary care physicians. The evidence indicates that young physicians are at higher risk for burnout compared with experienced physicians,[4] so future research should focus on prevention among less experienced physicians. Interventions focused on enhancing teamwork, mentoring, and leadership skills might be particularly suitable for young physicians and for physicians dealing with intense work and patients with complex care needs.[71-73]

Conclusions

This meta-analysis found that physicians could gain important benefits from interventions to reduce burnout, especially from organization-directed interventions. However, this evidence is derived from interventions developed and evaluated in diverse groups of physicians and health care settings. Burnout is associated with serious risks to both physicians and patients; thus, it is imperative that physicians have access to evidence-based interventions that reduce the risk for burnout.

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REFERENCES

1. Maslach C, Jackson S, Leiter M. *Maslach Burnout Inventory Manual*. Palo Alto, CA: Consulting Psychologists Press; 1996.

2. Maslach C, Schaufeli WB, Leiter MP. Job burnout. *Annu Rev Psychol*. 2001;52:397-422.

3. Shanafelt TD, Hasan O, Dyrbye LN, et al. Changes in burnout and satisfaction with work-life balance in physicians and the general US working population between 2011 and 2014. *Mayo Clinic Proc*. 2015;90(12):1600-1613.

4. Shanafelt TD, Boone S, Tan L, et al. Burnout and satisfaction with work-life balance among US physicians relative to the general US population. *Arch Intern Med*. 2012;172(18):1377-1385.

5. van der Heijden F, Dillingh G, Bakker A, Prins J. Suicidal thoughts among medical residents with burnout. *Arch Suicide Res*. 2008;12(4):344-346.

6. Wurm W, Vogel K, Holl A, et al. Depression-burnout overlap in physicians. *PLoS One*. 2016;11(3):e0149913.

7. Dewa CS, Loong D, Bonato S, Thanh NX, Jacobs P. How does burnout affect physician productivity? a systematic literature review. *BMC Health Serv Res*. 2014;14:325.

8. Dewa CS, Jacobs P, Thanh NX, Loong D. An estimate of the cost of burnout on early retirement and reduction in clinical hours of practicing physicians in Canada. *BMC Health Serv Res*. 2014;14:254.

9. Shanafelt TD, Mungo M, Schmitgen J, et al. Longitudinal study evaluating the association between physician burnout and changes in professional work effort. *Mayo Clin Proc*. 2016;91(4):422-431.

10. Shanafelt TD, Balch CM, Bechamps G, et al. Burnout and medical errors among American surgeons. *Ann Surg*. 2010;251(6):995-1000.

11. Fahrenkopf AM, Sectish TC, Barger LK, et al. Rates of medication errors among depressed and burnt out residents: prospective cohort study. *BMJ*. 2008;336(7642):488-491.

12. Dyrbye LN, Varkey P, Boone SL, Satele DV, Sloan JA, Shanafelt TD. Physician satisfaction and burnout at different career stages. *Mayo Clin Proc*. 2013;88(12):1358-1367.

13. Ratanawongsa N, Roter D, Beach MC, et al. Physician burnout and patient-physician communication during primary care encounters. *J Gen Intern Med*. 2008;23(10):1581-1588.

14. West CP, Huschka MM, Novotny PJ, et al. Association of perceived medical errors with resident distress and empathy: a prospective longitudinal study. *JAMA*. 2006;296(9):1071-1078.

15. West CP, Tan AD, Habermann TM, Sloan JA, Shanafelt TD. Association of resident fatigue and distress with perceived medical errors. *JAMA*. 2009;302(12):1294-1300.

16. Wallace JE, Lemaire JB, Ghali WA. Physician wellness: a missing quality indicator. *Lancet*. 2009;374(9702):1714-1721.

17. Linzer M, Visser MR, Oort FJ, Smets EM, McMurray JE, de Haes HC; Society of General Internal Medicine (SGIM) Career Satisfaction Study Group (CSSG). Predicting and preventing physician burnout: results from the United States and the Netherlands. *Am J Med*. 2001;111(2):170-175.

18. Montgomery A. The inevitability of physician burnout: implications for interventions. *Burn Res*. 2014;1(1):50-56.

19. Lown M, Lewith G, Simon C, Peters D. Resilience: what is it, why do we need it, and can it help us? *Br J Gen Pract*. 2015;65(639):e708-e710.

20. Awa WL, Plaumann M, Walter U. Burnout prevention: a review of intervention programs. *Patient Educ Couns*. 2010;78(2):184-190.

21. Regehr C, Glancy D, Pitts A, LeBlanc VR. Interventions to reduce the consequences of stress in physicians: a review and meta-analysis. *J Nerv Ment Dis*. 2014;202(5):353-359.

22. Dyrbye LN, Shanafelt TD. Physician burnout: a potential threat to successful health care reform. *JAMA*. 2011;305(19):2009-2010.

23. Ruotsalainen JH, Verbeek JH, Mariné A, Serra C. Preventing occupational stress in healthcare workers. *Cochrane Database Syst Rev*. 2015;(4):CD002892.

24. Moher D, Liberati A, Tetzlaff J, Altman DG; PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *BMJ*. 2009;339:b2535.

25. Effective Practice and Organisation of Care (EPOC) Group. *Suggested Risk of Bias Criteria for EPOC Reviews*. Oslo, Norway: Norwegian Knowledge Centre for the Health Services; 2014.

26. Borenstein M, Rothstein D, Cohen D. *Comprehensive Meta-analysis: A Computer Program for Research Synthesis*. Englewood, NJ: Biostat; 2005.

27. Kontopantelis E, Reeves D. metaan: random-effects meta-analysis. *Stata J*. 2010;10(3):395-407.

28. Brenninkmeijer V, VanYperen N. How to conduct research on burnout: advantages and disadvantages of a unidimensional approach in burnout research. *Occup Environ Med*. 2003;60(suppl 1):i16-i20.

29. Deeks JJ, Higgins JPT, Altman DG. Undertaking subgroup analyses. In: Higgins JPT, Green S, eds. *Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0*. Cochrane Collaboration; 2011. http://handbook.cochrane.org. Accessed July 10, 2016.

30. Higgins JP, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. *BMJ*. 2003;327(7414):557-560.

31. Brockwell SE, Gordon IR. A comparison of statistical methods for meta-analysis. *Stat Med*. 2001;20(6):825-840.

32. Kontopantelis E, Reeves D. Performance of statistical methods for meta-analysis when true study effects are non-normally distributed: a comparison between DerSimonian-Laird and restricted maximum likelihood. *Stat Methods Med Res*. 2012;21(6):657-659.

33. Sterne JA, Gavaghan D, Egger M. Publication and related bias in meta-analysis: power of statistical tests and prevalence in the literature. *J Clin Epidemiol*. 2000;53(11):1119-1129.

34. Egger M, Davey Smith G, Schneider M, Minder C. Bias in meta-analysis detected by a simple, graphical test. *BMJ*. 1997;315(7109):629-634.

35. Sterne JAC, Harbord RM. Funnel plots in meta-analysis. *Stata J*. 2004;4(2):127-141.

36. Harbord RM, Harris RJ, Sterne JAC. Updated tests for small-study effects in meta-analyses. *Stata J*. 2009;9(2):197-210.

37. Ali NA, Hammersley J, Hoffmann SP, et al; Midwest Critical Care Consortium. Continuity of care in intensive care units: a cluster-randomized trial of intensivist staffing. *Am J Respir Crit Care Med*. 2011;184(7):803-808.

38. Amutio A, Martínez-Taboada C, Delgado LC, Hermosilla D, Mozaz MJ. Acceptability and effectiveness of a long-term educational intervention to reduce physicians' stress-related conditions. *J Contin Educ Health Prof*. 2015;35(4):255-260.

39. Asuero AM, Queraltó JM, Pujol-Ribera E, Berenguera A, Rodriguez-Blanco T, Epstein RM. Effectiveness of a mindfulness education program in primary health care professionals: a pragmatic controlled trial. *J Contin Educ Health Prof*. 2014;34(1):4-12.

40. Bragard I, Etienne AM, Merckaert I, Libert Y, Razavi D. Efficacy of a communication and stress management training on medical residents' self-efficacy, stress to communicate and burnout:

a randomized controlled study. *J Health Psychol*. 2010;15(7):1075-1081.

41. Butow P, Brown R, Aldridge J, et al. Can consultation skills training change doctors' behaviour to increase involvement of patients in making decisions about standard treatment and clinical trials: a randomized controlled trial. *Health Expect*. 2015;18(6):2570-2583.

42. Butow P, Cockburn J, Girgis A, et al; CUES Team. Increasing oncologists' skills in eliciting and responding to emotional cues: evaluation of a communication skills training program. *Psychooncology*. 2008;17(3):209-218.

43. Garland A, Roberts D, Graff L. Twenty-four-hour intensivist presence: a pilot study of effects on intensive care unit patients, families, doctors, and nurses. *Am J Respir Crit Care Med*. 2012;185(7):738-743.

44. Gunasingam N, Burns K, Edwards J, Dinh M, Walton M. Reducing stress and burnout in junior doctors: the impact of debriefing sessions. *Postgrad Med J*. 2015;91(1074):182-187.

45. Linzer M, Poplau S, Grossman E, et al. A cluster randomized trial of interventions to improve work conditions and clinician burnout in primary care: results from the Healthy Work Place (HWP) study. *J Gen Intern Med*. 2015;30(8):1105-1111.

46. Lucas BP, Trick WE, Evans AT, et al. Effects of 2- vs 4-week attending physician inpatient rotations on unplanned patient revisits, evaluations by trainees, and attending physician burnout: a randomized trial. *JAMA*. 2012;308(21):2199-2207.

47. Margalit APA, Glick SM, Benbassat J, Cohen A, Katz M. Promoting a biopsychosocial orientation in family practice: effect of two teaching programs on the knowledge and attitudes of practising primary care physicians. *Med Teach*. 2005;27(7):613-618.

48. Martins AE, Davenport MC, Del Valle MP, et al. Impact of a brief intervention on the burnout levels of pediatric residents. *J Pediatr (Rio J)*. 2011;87(6):493-498.

49. Milstein JM, Raingruber BJ, Bennett SH, Kon AA, Winn CA, Paterniti DA. Burnout assessment in house officers: evaluation of an intervention to reduce stress. *Med Teach*. 2009;31(4):338-341.

50. Parshuram CS, Amaral ACKB, Ferguson ND, et al; Canadian Critical Care Trials Group. Patient safety, resident well-being and continuity of care with different resident duty schedules in the intensive care unit: a randomized trial. *CMAJ*. 2015;187(5):321-329.

51. Ripp JA, Bellini L, Fallar R, Bazari H, Katz JT, Korenstein D. The impact of duty hours restrictions on job burnout in internal medicine residents: a three-institution comparison study. *Acad Med*. 2015;90(4):494-499.

52. Shea JA, Bellini LM, Dinges DF, et al. Impact of protected sleep period for internal medicine interns on overnight call on depression, burnout, and empathy. *J Grad Med Educ*. 2014;6(2):256-263.

53. Verweij H, Waumans RC, Smeijers D, et al. Mindfulness-based stress reduction for GPs: results of a controlled mixed methods pilot study in Dutch primary care. *Br J Gen Pract*. 2016;66(643):e99-e105.

54. Weight CJ, Sellon JL, Lessard-Anderson CR, Shanafelt TD, Olsen KD, Laskowski ER. Physical activity, quality of life, and burnout among physician trainees: the effect of a team-based, incentivized exercise program. *Mayo Clin Proc*. 2013;88(12):1435-1442.

55. West CP, Dyrbye LN, Rabatin JT, et al. Intervention to promote physician well-being, job satisfaction, and professionalism: a randomized clinical trial. *JAMA Intern Med*. 2014;174(4):527-533.

56. Sterne JA, Sutton AJ, Ioannidis JP, et al. Recommendations for examining and interpreting funnel plot asymmetry in meta-analyses of randomised controlled trials. *BMJ*. 2011;343:d4002.

57. Kontopantelis E, Springate DA, Reeves D. A re-analysis of the Cochrane Library data: the dangers of unobserved heterogeneity in meta-analyses. *PLoS One*. 2013;8(7):e69930.

58. Higgins JP, Thompson SG. Quantifying heterogeneity in a meta-analysis. *Stat Med*. 2002;21(11):1539-1558.

59. Gotzsche PC. Why we need a broad perspective on meta-analysis: it may be crucially important for patients. *BMJ*. 2000;321(7261):585-586.

60. Burke JF, Sussman JB, Kent DM, Hayward RA. Three simple rules to ensure reasonably credible subgroup analyses. *BMJ*. 2015;351:h5651.

61. Sedgwick P. Meta-analyses: heterogeneity and subgroup analysis. *BMJ*. 2013;346:f4040.

62. Murray M, Murray L, Donnelly M. Systematic review of interventions to improve the psychological well-being of general practitioners. *BMC Fam Pract*. 2016;17(1):36.

63. West CP, Dyrbye LN, Erwin PJ, Shanafelt TD. Interventions to prevent and reduce physician burnout: a systematic review and meta-analysis [published online September 28, 2016]. *Lancet*. doi: 10.1016/S0140-6736(16)31279-X.

64. Egan M, Bambra C, Thomas S, Petticrew M, Whitehead M, Thomson H. The psychosocial and health effects of workplace reorganisation. 1. a systematic review of organisational-level interventions that aim to increase employee control. *J Epidemiol Community Health*. 2007;61(11):945-954.

65. Swensen S, Kabcenell A, Shanafelt T. Physician-organization collaboration reduces physician burnout and promotes engagement: the Mayo Clinic experience. *J Healthc Manag*. 2016;61(2):105-127.

66. West CP, Hauer KE. Reducing burnout in primary care: a step toward solutions. *J Gen Intern Med*. 2015;30(8):1056-1057.

67. Dyrbye LN, Eacker A, Durning SJ, et al. The impact of stigma and personal experiences on the help-seeking behaviors of medical students with burnout. *Acad Med*. 2015;90(7):961-969.

68. Craig P, Dieppe P, Macintyre S, Michie S, Nazareth I, Petticrew M; Medical Research Council Guidance. Developing and evaluating complex interventions: the new Medical Research Council guidance. *BMJ*. 2008;337:a1655.

69. Moore GF, Audrey S, Barker M, et al. Process evaluation of complex interventions: Medical Research Council guidance. *BMJ*. 2015;350:h1258.

70. Johnson MJ, May CR. Promoting professional behaviour change in healthcare: what interventions work, and why? a theory-led overview of systematic reviews. *BMJ Open*. 2015;5(9):e008592.

71. Frich JC, Brewster AL, Cherlin EJ, Bradley EH. Leadership development programs for physicians: a systematic review. *J Gen Intern Med*. 2015;30(5):656-674.

72. Helfrich CD, Dolan ED, Simonetti J, et al. Elements of team-based care in a patient-centered medical home are associated with lower burnout among VA primary care employees. *J Gen Intern Med*. 2014;29(2)(suppl 2):S659-S666.

73. Fazio SB, Steinmann AF. A new era for residency training in internal medicine. *JAMA Intern Med*. 2016;176(2):161-162.

74. Hakanen JJ, Schaufeli WB. Do burnout and work engagement predict depressive symptoms and life satisfaction? a three-wave seven-year prospective study. *J Affect Disord*. 2012;141(2-3):415-424.