

1 **A systematic review and meta-analysis of controlled interventions to reduce burnout**  
2 **in physicians.**

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4 Maria Panagioti, PhD, NIHR School for Primary Care Research, Manchester Academic  
5 Health Science Centre, University of Manchester, M13 9PL, UK

6

7 Efharis Panagopoulou, PhD, Laboratory of Hygiene, Aristotle Medical School, Aristotle  
8 University of Thessaloniki, Greece

9

10 Peter Bower, PhD, NIHR School for Primary Care Research, Manchester Academic Health  
11 Science Centre, University of Manchester, M13 9PL, UK

12

13 George Lewith, MD, Complementary and Integrated Medicine Research Unit Primary  
14 Medical Care Alder Moor Health Centre Alder Moor Close Southampton SO16 5ST

15

16 Evangelos Kontopantelis, PhD, NIHR School for Primary Care Research, Manchester  
17 Academic Health Science Centre, University of Manchester, M13 9PL, UK

18 The Farr Institute for Health Informatics Research, Vaughan House, University of  
19 Manchester, Manchester, M13 9GB

20

21 Carolyn Chew-Graham, MD, Research Institute, Primary Care and Health Sciences, Keele  
22 University, Staffordshire, ST5 5BG, UK

23

24 Shoba Dawson, PhD, NIHR Greater Manchester Primary Care Patient Safety Translational  
25 Research Centre, Manchester Academic Health Science Centre, University of Manchester  
26 M13 9PL, UK

27

28 Harm van Marwijk, MD, NIHR Greater Manchester Primary Care Patient Safety  
29 Translational Research Centre, Manchester Academic Health Science Centre, University of  
30 Manchester, M13 9PL, UK

31

32 Keith Geraghty, PhD, NIHR School for Primary Care Research, Centre for Primary Care,  
33 Institute of Population Health, University of Manchester, M13 9PL, UK

34

35 Aneez Esmail, MD, NIHR Greater Manchester Primary Care Patient Safety Translational  
36 Research Centre, Manchester Academic Health Science Centre, University of Manchester,  
37 M13 9PL, UK

38

39 **\*Correspondence to**

40 Dr Maria Panagioti

41 Postal Address: NIHR School for Primary Care Research, Manchester Academic Health  
42 Science Centre, Williamson Building, Oxford Road, University of Manchester, Manchester,  
43 M13 9PL, UK.

44 e: maria.panagioti@manchester.ac.uk

45 t: +44 (0) 161 3060665

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47 This manuscript has not been presented at any academic meeting.

48

49 **Author Contributions**

50 The original idea for the research was developed by MP, EF, and AE. The analysis was  
51 conducted by MP with input from EK, EP, PB, and AE. MP, KG and SD conducted the  
52 searches, study selection, quality assessments and other data extraction. MP wrote the

53 paper. All authors interpreted the findings and contributed to critical revision of the  
54 manuscript. MP is the guarantor. MP affirms that the manuscript is an honest, accurate, and  
55 transparent account of the research findings and no important aspects of the study have  
56 been omitted.

57

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59 All authors declare no conflict of interest

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79 **Abstract**

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

83 **OBJECTIVE:** To evaluate the effectiveness of interventions to reduce burnout in physicians.  
84 We also examined whether different types of interventions (physician-directed or  
85 organization-directed interventions), physician characteristics (length of experience) and  
86 healthcare setting characteristics (primary or secondary care) were associated with  
87 improved effects.

88 **DATA SOURCES:** Medline, Embase, PsycINFO, Cinahl, and Central, were searched from  
89 inception to May 2016. The reference lists of eligible studies and other relevant systematic  
90 reviews were hand-searched.

91 **STUDY SELECTION:** Randomized controlled trials and controlled before-after studies of  
92 interventions targeting burnout in physicians.

93 **DATA EXTRACTION AND SYNTHESIS:** Two independent reviewers extracted data and  
94 assessed the risk of bias. The main meta-analysis was followed by a number of pre-specified  
95 subgroup and sensitivity analyses. All analyses were performed using random-effects models  
96 and heterogeneity was quantified using  $I^2$ .

97 **MAIN OUTCOME AND MEASURES:** The core outcome was burnout scores focused on  
98 emotional exhaustion, reported as standardized mean differences and their 95% confidence  
99 intervals.

100 **RESULTS:** Twenty independent comparisons from 19 studies were included in the meta-  
101 analysis (n=1,550 physicians). Interventions were associated with small significant reductions  
102 in burnout (SMD=-0.29, 95% CI=-0.42 to -0.16; equal to a drop of 3-points on the  
103 emotional exhaustion domain of the Maslach Burnout Inventory above change in the  
104 controls). Subgroup analyses suggested significantly improved effects for organization-

105 directed interventions (SMD=-0.45, 95% CI=-0.62 to -0.28) compared to physician-directed  
106 interventions (SMD=-0.18, 95% CI=-0.32 to -0.03). Interventions delivered in experienced  
107 physicians and in primary care were associated with higher effects compared to  
108 interventions delivered in inexperienced physicians and in secondary care, but these  
109 differences were not significant. The results were not influenced by the risk of bias ratings.

110 **CONCLUSION:** Evidence from this meta-analysis suggests that current intervention  
111 programs for burnout in physicians are associated with small benefits which may be boosted  
112 by adoption of organization-directed approaches. This finding provides support for the view  
113 that burnout is a problem of the whole healthcare organization, rather than individuals.

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131 **Introduction**

132 Burnout is a syndrome consisting of emotional exhaustion, depersonalization, and a  
133 diminished sense of personal accomplishment, which is primarily driven by workplace  
134 stressors.<sup>1-3</sup> Burnout is a major concern for physicians. Nearly half of practicing  
135 physicians in the United States experience burnout at some point in their career<sup>4</sup>  
136 Although there are substantial differences by specialty, physicians at the front line of  
137 care report the highest rates of burnout.<sup>5</sup>

138

139 Burnout has serious negative consequences for physicians, the healthcare system and  
140 for patient outcomes. Burnout in physicians has been linked with lower work  
141 satisfaction, disrupted personal relationships, substance misuse, depression, and  
142 suicide.<sup>6,7</sup> Within health care organizations, burnout is related to reduced  
143 productivity, high job turnover and early retirement.<sup>8,9,10</sup> Importantly, burnout can  
144 result in an increase in medical errors, reduced quality of patient care and lower  
145 patient satisfaction.<sup>11-16</sup> It is not surprising therefore, that wellness of physicians is  
146 increasingly proposed as a quality indicator in healthcare delivery.<sup>17</sup>

147

148 Leading drivers of burnout include excessive workload, imbalance between job  
149 demands and skills, a lack of job control, and prolonged work stress.<sup>18</sup> Recently,  
150 there has been a shift from viewing burnout as an individual problem, to a problem  
151 of the healthcare organization as a whole; rooted in issues related to working  
152 environment and organizational culture.<sup>19</sup> It has been suggested that reducing risk of  
153 burnout in physicians requires change in organizations, as well as support for  
154 individual physicians.<sup>20</sup>

155

156 Interventions for burnout can be classified into two main categories, physician-  
157 directed interventions targeting individuals and organization-directed interventions  
158 targeting the working environment.<sup>21,22</sup> Physician-directed interventions typically  
159 involve mindfulness techniques or cognitive behavioral techniques to enhance job  
160 competence, improve communication skills and personal coping strategies.

161 Organization-directed interventions can involve simple changes in schedule and  
162 reductions in the intensity of workload or more ambitious changes to the operation  
163 of practices and whole healthcare organizations. These usually involve improved  
164 team-working, changes in work evaluation, supervision to reduce job demand and  
165 enhance job control, and increasing the level of participation in decision making.

166

167 We conducted a systematic review and meta-analysis of studies which evaluated  
168 interventions to reduce burnout in physicians. We decided to focus on burnout  
169 scores as the main outcome of this review because burnout is the best recognized  
170 serious negative consequence of work stress in physicians<sup>19,23</sup> and the most  
171 commonly reported, and consistently measured, outcome of work stress  
172 interventions.<sup>21,22,24</sup> Moreover, by focusing on burnout, we established a level of  
173 homogeneity in terms of outcomes which allowed us to test our aims meta-  
174 analytically.

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176 Our first objective was to assess the effectiveness of interventions in reducing  
177 burnout. Second, we examined what types of interventions are the most effective  
178 (organization-directed, physician-directed). Thirdly, we examined whether there are  
179 any differences in the effect of interventions in different healthcare settings (primary  
180 care, secondary/intensive care) and in physicians with different levels of working  
181 experience. Our rationale was that physicians working in different organizational

182 settings or physicians with different levels of experience might have diverse needs  
183 and might respond differently to burnout interventions.

184

## 185 **Methods**

186 The reporting of the review adheres to the Preferred Reporting Items for Systematic  
187 Reviews and Meta-Analyses (PRISMA) statement (eTable I).<sup>25</sup> The protocol is included in  
188 eMethods I.

189

## 190 **Eligibility criteria**

- 191 • **Population:** Physicians of any specialty in primary, secondary or intensive care  
192 setting including residents and fellows. Studies based on a mix of physicians and  
193 other healthcare professionals were included in the review if the physicians  
194 comprised 70% of the sample.
- 195 • **Intervention:** Any intervention designed to improve stress/performance of  
196 physicians and reported burnout outcomes including physician-directed  
197 interventions and organization-directed interventions. Physician-directed  
198 interventions focused on individuals (e.g. cognitive behavioral therapies,  
199 mindfulness stress reduction techniques, educational programs for improving  
200 communication skills) whereas organization-directed interventions introduced  
201 changes in the resources, the working environment, work tasks to decrease  
202 stress (e.g. changes in the intensity/schedule of workload or deeper  
203 improvements in the operation of healthcare organizations and the teamwork).
- 204 • **Comparison:** Any type of control (e.g. waiting list or no intervention)
- 205 • **Outcome:** Burnout measured using validated tools such as the Maslach Burnout  
206 Inventory (MBI),<sup>1</sup> or other validated measures that measured burnout.



207 • Study design: Quantitative intervention designs described in the Cochrane  
208 handbook including RCTs, non-randomized trials, controlled before-after studies  
209 and interrupted time-series.

210 • Context: Any healthcare setting including primary care and secondary care.

211

212 Exclusion criteria:

213 • Interventions not reporting data on burnout outcomes but providing data on  
214 general stress, well-being or job satisfaction.

215 • Grey literature

216

## 217 **Search strategy and data sources**

218 Five electronic bibliographic databases were searched from inception until May 2016:

219 MEDLINE, EMBASE, CINAHL, Cochrane Register of Controlled Trials and PsycINFO. The  
220 search strategy included combinations of three key blocks of terms (burnout; physicians;  
221 interventions) using medical subject headings (MESH terms) and text-words (eMethods2).

222 Searches were supplemented by hand searches of the reference lists of eligible studies and  
223 systematic reviews.

224

## 225 **Study selection**

226 The results of the searches were exported in Endnote and duplicates were removed. Study  
227 selection was completed in two stages. First, the titles and abstracts of the studies were  
228 screened and subsequently the full-texts of relevant studies were accessed and further  
229 screened against the eligibility criteria. The title/abstract screening was undertaken by the  
230 first author whereas two independent reviewers were involved in full-text screening. Inter-  
231 rater reliability was high (kappa = 0.96). Disagreements were resolved through discussions.

232

233 **Data extraction**

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

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

243

244 **Risk of bias assessment**

245 The critical appraisal of the studies was performed using the Effective Practice and  
246 Organisation of Care (EPOC) risk of bias tool.<sup>26</sup> EPOC was chosen because it is appropriate  
247 for use across all types of intervention designs described in the Cochrane handbook. The  
248 EPOC tool contains nine standardized criteria scored on a 3-point scale, corresponding to  
249 low, unclear, and high risk.

250

251 **Data analysis**

252 Standardized Mean Differences (SMDs) and associated confidence intervals (CI) for  
253 the burnout outcomes of all the studies were calculated in Comprehensive Meta-  
254 Analysis (CMA).<sup>27</sup> The pooled SMDs and the forest plots were computed using the  
255 metan command in Stata 14.<sup>28</sup> The main meta-analysis evaluated the effectiveness of  
256 the interventions in reducing burnout. The MBI measure for burnout provides

257 ratings in three domains (emotional exhaustion, depersonalization and personal  
258 accomplishment). It is not recommended they are combined.<sup>1</sup> In line with previous  
259 meta-analyses, we used only the emotional exhaustion domain of MBI in the  
260 analyses.<sup>29</sup> Emotional exhaustion is considered the most central aspect of burnout  
261 (some studies only use this domain) and other unidimensional measures of burnout  
262 focus on emotional exhaustion.<sup>29,30</sup> To ease the interpretation of the results we  
263 “back-transformed” the pooled SMD to a mean difference for the emotional  
264 exhaustion subscale, under certain assumptions. When data were available for more  
265 than one follow-up assessment points, the short-term assessment point were  
266 inserted in the main analysis. Three pre-specified subgroup analyses<sup>31</sup> were carried  
267 out:

- 268 i. *Type of interventions* – we tested the effectiveness of physician-directed, and  
269 organization-directed interventions.
- 270 ii. *Working experience of physicians* – we examined the differential treatment  
271 effects across studies recruited physicians with extensive working experience  
272 (mean = 5 years or more) and studies recruited physicians with low  
273 experience (mean= less than 5 years). All studies classified into the low  
274 experience category explicitly reported in the methods that they recruited  
275 junior physicians.
- 276 iii. *Healthcare setting*– we tested the effects of interventions separately in  
277 physicians based in primary care and in secondary care.

278

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

283

284 Heterogeneity was assessed using the  $I^2$  statistic. Conventionally,  $I^2$  values of 25%,  
285 50%, and 75% indicate low, moderate, and high heterogeneity.<sup>32</sup> All analyses were  
286 conducted using a random effects model, even if  $I^2$  was low. Random-effects models  
287 are more conservative and have better properties in the presence of any  
288 heterogeneity.<sup>33,34</sup> The Cohen's Q test of between group variance was used to test  
289 whether the effectiveness of burnout interventions is significantly different across  
290 sub-groups. Cluster RCTs were identified and the precision of analyses adjusted  
291 using a sample size/variation inflation method, assuming an intra-class correlation of  
292 0.02. Provided we identified 10 or more studies,<sup>35</sup> we aimed to use funnel plots and  
293 Egger's test to assess small sample bias (an indicator of possible publication bias).<sup>36</sup>  
294 Funnel plots were constructed using the metafunnel command,<sup>37</sup> and the Egger test  
295 was computed using the metabias command.<sup>38</sup>

296

## 297 **Results**

298 The search strategy yielded 2,322 articles. Following the removal of duplicates, 1723 articles  
299 were retained for title and abstract screening. Of these, 75 were relevant for full-text  
300 screening and 19 studies were included in the review.<sup>39-57</sup> One study included a marginally  
301 lower percentage of physicians (67%) but we retained it in the analyses to maximize the  
302 evidence base.<sup>41</sup>

303

## 304 **Characteristics of studies and physicians**

305 Table I presents the characteristics of the 19 studies (including 20 independent comparisons  
306 on 1,550 physicians, mean age=40.3 years). Eight studies were conducted in the US (42%),  
307 four in Europe, three in Australia, two in Canada, one in Argentine and one in Israel. A  
308 higher proportion of men were recruited in the majority of studies.

309

310 Seven studies recruited physicians working in primary care (mostly labelled 'general  
311 practitioners'), ten studies recruited physicians in secondary care (e.g. physicians in intensive  
312 care units, oncologists and surgeons) and two studies recruited a mixed sample of physicians  
313 who were recruited through their registration in national medical associations. Across all  
314 interventions, the main eligibility criteria were being a physician (working on a specific  
315 setting in most cases) and willingness to take part in the study. None of the studies  
316 specifically targeted physicians with certain severity levels of burnout. The majority of  
317 studies (n=12; 67%) were based on experienced physicians (mean working experience= 5  
318 years and over) whereas seven studies were based on recently qualified physicians (mean  
319 working experience=less than 5 years). With the exception of one study,<sup>39</sup> all used the MBI  
320 to assess the severity of burnout (eTable 2).

321

### 322 **Characteristics of Interventions**

323 Interventions varied considerably in their characteristics including content,  
324 duration/intensity, and length of post-intervention assessment points (see Table 1).  
325 The majority (n=12; 60%) were physician-directed interventions which comprised  
326 mindfulness stress reduction techniques, educational interventions targeting  
327 physicians' self-confidence and communication skills, exercise or a combination of  
328 these features.

329

330 Within the category of organization-directed interventions, five studies evaluated  
331 simple workload interventions which focused on rescheduling hourly shifts and  
332 reducing workload. Only three studies tested more extensive organization-directed  
333 interventions incorporating discussion meetings to enhance teamwork and

334 leadership, structural changes, and elements of physician interventions such as  
335 communication skills training and mindfulness.

336

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

340

### 341 **Risk of bias characteristics**

342 The results of the risk of bias assessment are presented in eFigure 1. Eighteen  
343 comparisons were RCTs (95%) whereas two were CBA. Fifteen comparisons (75%)  
344 fulfilled 6 of the 9 risk of bias criteria (a higher score indicates lower vulnerability to  
345 bias). Three comparisons fulfilled 8 to 9 criteria (17%) while 5 fulfilled 4 or fewer  
346 criteria (25%); most moderately accounted for the risk of bias criteria.

347

### 348 **Main meta-analysis: Effectiveness of interventions in reducing burnout**

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

353

### 354 **Subgroup analyses**

355 **Types of interventions:** Physician-directed interventions were associated with small  
356 significant reductions in burnout (SMD=-0.18, 95% CI=-0.32 to -0.03,  $I^2=11%$ , 95%CI=0 to  
357 49; back-transformed emotional exhaustion score =16.2, 95%CI=14.7 to 17.3 compared to a  
358 control group score of 17.9) whereas organization-directed interventions were associated  
359 with medium significant reductions in burnout (SMD=-0.45, 95% CI=-0.62 to -0.28,  $I^2=19%$ ,

360 95%CI=0 to 60; back-transformed emotional exhaustion score=13.9, 95% CI=12.4 to 14.7  
361 compared to a control group score of 17.9; Figure 3). The effects of organization-directed  
362 interventions were significantly larger than the effects of physician-directed interventions  
363 (Cohen's  $Q = 4.15$ ,  $P=0.04$ ).

364

365 **Working experience:** The pooled effect of interventions on burnout scores was medium  
366 and significant across studies mainly based on experienced physicians (SMD=-0.37, 95% CI=  
367 -0.58 to -0.16,  $I^2=42%$ , 95%CI=0 to 70; back-transformed emotional exhaustion score =14.6,  
368 95%CI=12.7 to 16.5 compared to a control group score of 17.9) and small and significant  
369 across studies on physicians with limited experience (SMD=-0.27, 95% CI=-0.40 to -0.14,  
370  $I^2=0%$ , 95%CI=0 to 75; back-transformed emotional exhaustion score =15.5, 95%CI=13.8 to  
371 16.9 compared to a control group score of 17.9; eFigure 2). This group difference was non-  
372 significant ( $Q=0.92$ ,  $P=0.34$ ).

373

374 **Healthcare setting:** Interventions in primary care were associated with small to medium  
375 reductions in burnout (SMD=-0.39, 95% CI=-0.59 to -0.19,  $I^2=4%$ , 95%CI=0 to 69; back-  
376 transformed emotional exhaustion score =14.4, 95%CI=12.6 to 16.2 compared to a control  
377 group score of 17.9). Interventions in secondary care were associated with small significant  
378 reductions in burnout (SMD=-0.24, 95% CI=-0.41 to -0.07,  $I^2=41%$ , 95%CI=0 to 65; back-  
379 transformed emotional exhaustion score = 15.7, 95%CI=13.9 to 17.4 compared to a control  
380 group score of 17.9; eFigure 3). This difference was non-significant ( $Q=0.51$ ,  $P=0.48$ ).

381

### 382 **Sensitivity analyses**

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

386

387 Interventions were associated with very small significant reductions in depersonalization  
388 (SMD=-0.21, 95% CI=-0.35 to -0.06,  $I^2=33%$ , 95%CI=0 to 68%; eFigure 5) and small  
389 improvements in the personal accomplishment (SMD=0.30, 95% CI=0.15 to 0.45,  $I^2=0%$ ,  
390 95%CI=0 to 58%; eFigure 6). The subgroup analyses in these two domains showed similar  
391 results but were based on a smaller number of studies (eTable 3).

392

### 393 **Small study bias**

394 We found no evidence of funnel plot asymmetry which might indicate publication bias for  
395 the main, or subgroup analyses (Egger test  $P=0.11$  for main analysis; Figure 4).

396

## 397 **Discussion**

### 398 **Summary of main findings**

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

405

### 406 **Strengths and limitations**

407 This is a comprehensive meta-analysis of controlled interventions aimed at reducing  
408 physician burnout. The two greatest threats for the validity of meta-analysis are  
409 heterogeneity and publication bias. However, the biggest strength of this work is the large  
410 number of identified and meta-analyzed controlled comparisons (20, when approximately  
411 11.5% of all meta-analyses include 10 or more studies), which allows us to reliably estimate



412 and model heterogeneity levels.<sup>58</sup> In addition, the size of the meta-analysis allowed us to  
413 assess publication bias with adequate power.<sup>35</sup> Although publication bias tests are rarely  
414 conclusive, we did not observe any bias indications in the plot or test.

415

416 The included studies differed significantly in terms of content of interventions, study  
417 design/quality and length of follow-up which limit the extent to which broad conclusions can  
418 be made about the overall effectiveness of physician interventions. However, estimates of  
419 heterogeneity in the pooled analyses were low to moderate by conventional thresholds and  
420 random effects models were applied in all analyses.<sup>59</sup> Heterogeneity was further addressed  
421 by conducting pre-specified subgroup analyses (within the limits of power).<sup>60</sup> While this is a  
422 useful approach for producing guidance to design and deliver the most effective  
423 interventions, subgroup analyses should be interpreted cautiously because other,  
424 uncontrolled differences between studies might account for the results.<sup>61,62</sup>

425

### 426 **Comparison with previous systematic reviews**

427 Three existing systematic reviews examined the effectiveness of work stress interventions in  
428 healthcare professionals with only one of these specifically focused on physicians.<sup>22,63,64</sup> Our  
429 findings regarding the overall effectiveness of burnout interventions and the increased  
430 effectiveness of organizational interventions are in agreement with the most recent meta-  
431 analysis on physician burnout.<sup>64</sup> In comparison, we narrowed our attention to controlled  
432 interventions and we undertook an additional evidence-based pre-specified subgroup  
433 analyses to examine whether the characteristics of interventions, physicians and healthcare  
434 settings influence the overall effect of burnout interventions. This decision was based on  
435 the recognition that controlled interventions offer the best opportunity to reach rigorous  
436 conclusions about the effectiveness of the tested interventions and that intervention studies  
437 on physician burnout are highly heterogeneous. This approach enabled us to draw

438 informative conclusions for the effectiveness of burnout interventions among physicians  
439 which take into account the influence of the distinct features of interventions, physicians and  
440 healthcare settings.

441

#### 442 **Implications for researchers, clinicians and policymakers**

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

449

450 Organization-directed interventions were more likely to lead to reductions in burnout but  
451 there were large variations in terms actual approaches, intervention ingredients and  
452 intensity. Those which combined several elements such as structural changes, fostering  
453 communication between members of the healthcare teams and cultivating a sense of team-  
454 work and job control tended to be the most effective in reducing burnout.<sup>47</sup> However, such  
455 intense organization-directed interventions were rare and were not evaluated widely. The  
456 majority of organization-directed interventions, which we included in the analyses,  
457 introduced simple reductions in the workload or schedule. Concerns around  
458 implementation and delivery costs of organization-directed interventions, especially if they  
459 involve complex and major healthcare system changes, might explain their scarcity.<sup>21,65</sup> A  
460 recent example promoting healthy individual-organization relationships is the Listen-Act-  
461 Develop model implemented in Mayo Clinic.<sup>66</sup> Large-scale cluster-randomized trials of such  
462 programs at institutional or even at national level which emphasize organizational culture by

463 creating a safe space for staff to acknowledge and decrease stress are possibly an optimal  
464 framework for mitigating burnout.

465

466 Physician-directed interventions led to marginally significant and very small reductions in  
467 burnout. We found no evidence that the content (e.g. mindfulness, communicational,  
468 educational components) or intensity of these interventions might increase the derived  
469 benefits based on our critical review. This finding in combination with the larger effects of  
470 organization-directed interventions, support the argument that burnout is rooted in the  
471 organizational coherence of the healthcare system.<sup>20,67</sup> If burnout is a problem of whole  
472 healthcare systems it is less likely to be effectively minimized by solely intervening at the  
473 individual level. It requires an organization-embedded approach.<sup>68</sup> Moreover, physicians  
474 expected to deal with burnout individually and remotely from their practicing organization  
475 might view physician-directed interventions as a personal responsibility (or blame  
476 themselves for being less 'resilient') rather than as a shared resource to create a flourishing  
477 healthcare environment.<sup>66,69</sup> There is some evidence that elements of the physician-directed  
478 interventions (e.g. mindfulness) are effective when supported by organizational  
479 approaches.<sup>24,70</sup> However, other unexamined factors at the process of the intervention  
480 delivery or at participant level might account for the observed differences in the  
481 effectiveness of organization-directed and physician-directed interventions. Research  
482 programs to understand the best context for the delivery, evaluation and the  
483 implementation of burnout interventions are required.<sup>71-73</sup>

484

485 Physicians based in different healthcare settings or at different stages of their career might  
486 face unique challenges and have different needs. We found smaller benefits for recently  
487 qualified and secondary care physicians. The evidence indicates that young physicians are at  
488 higher risk for burnout compared to experienced physicians,<sup>5</sup> so future research should

489 focus on prevention among less experienced physicians. Interventions focused on enhancing  
490 teamwork, mentoring and leadership skills might be particularly suitable for young physicians  
491 and for physicians dealing with intense work and complex patients.<sup>74-76</sup>

492

## 493 **Conclusion**

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

500

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720 Figure 1: PRISMA flowchart

721 *Figure legend: Flowchart of the inclusion of studies in the review*

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723 Figure 2: Forest plot of the effects of interventions on burnout scores

724 *Figure legend: Meta-analysis of individual study and pooled effects. Each line represents one study in*  
725 *the meta-analysis, plotted according to the standardized mean difference (SMD – roughly the*  
726 *difference between the average score of participants in the intervention group, and the average*  
727 *score of participants in the control group). The black box on each line shows the SMD for each*  
728 *study and the blue box represents the pooled SMD. Random effects model used. 95% CI=95%*  
729 *confidence intervals.*

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731 Figure 3: Forest plot of the effects of different types of interventions on burnout scores

732 *Figure legend: Subgroup analysis of individual study and pooled effects of physician-directed and*  
733 *organization-directed interventions on burnout scores. Each line represents one study in the meta-*  
734 *analysis, plotted according to the standardized mean difference (SMD). The black box on each line*  
735 *shows the SMD for each study and the blue box represents the pooled SMD. Random effects model*  
736 *used. 95% CI=95% confidence intervals; ES=Standardized mean difference*

737

738 Figure 4: Funnel plot of standardized mean differences versus standard error for burnout

739 scores

740 *Figure legend: Funnel plot with pseudo 95% confidence intervals. The outer lines indicate the*  
741 *triangular region within which 95% of studies are expected to lie in the absence of both biases and*  
742 *heterogeneity. Funnel plot shows no substantial asymmetry (Egger's regression intercept  $-0.28$ ,*  
743  *$SE=0.16$ ,  $P=0.11$ )<sup>77</sup>*

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**Table 1: Characteristics of studies and interventions included in this review**

Study	Country	Recruitment and eligibility	Health care setting	N	Males	Mean Age	Work years	Research design	Intervention	Control	Follow-up point
Ali et al. <sup>39</sup> 2011	US	Physicians with various specialties working in intensive care units.	Intensive care	45	76%	M=41 years	M=8 years	Cluster RCT	<i>Organization-directed (focused on workload or schedule):</i> Two intensivist staffing schedules were compared: continuous and interrupted (rotations every 2 weeks) for 14 months.	Continuous schedule	9 months
Amutio et al. <sup>40</sup> 2015	Spain	Physicians with various specialties registered in a national medical organization.	Mixed sample of physicians; Registration in a medical professional organization	42	43%	M=43 years	M=9 years	RCT	<i>Physician-directed:</i> A 2-month mindfulness-based stress reduction program which involved a weekly powerpoint presentation of stressful topics related to the medical profession (ie. healing with suffering), a weekly 45 minute mindfulness exercise, a weekly 60-minute group reflection about the weekly topic and the mindfulness exercise.	Waiting list	1 month
Asuero et al. <sup>41</sup> 2014	Spain	Physicians and allied health professionals in	Primary care	68	8%	M=47 years	M=10 years	RCT	<i>Physician-directed:</i> A 2-month (8 sessions of 2.5 hours per week plus a 1-	Waiting list	2 months

		primary care were invited to participate.							day session of 8 hours) contemplation-meditation exercises such as mindfulness meditation, where participants focus on the present-moment experience and contemplate nonjudgmentally bodily sensations, breathing, sounds, and thoughts.		
Bragard et al. <sup>42</sup> 2010	Belgium	Internal medicine residents with an interest in a psychological training and to be willing to participate in the training program.	University- based hospital	113	60%	M=28 years	M=3 years	RCT	<i>Physician-directed:</i> a 30-hour communication skills training and a 10-hour stress management skills training in small groups (up to seven participants).	Waiting list	2 months
Butow et al. <sup>44</sup> 2008	Australia	Oncologists from six tertiary care hospitals in six Australian cities which incorporated oncology outpatient clinics were eligible.	Teaching hospitals, oncology unit	30	50%	M=44 years	M=16 years	RCT	<i>Physician-directed:</i> 1.5-day intensive face to face workshop with three to six participants incorporating presentation of principles, a DVD modelling ideal behavior and role-play practice, followed by four 1.5 hour video-conferences at monthly intervals	Waiting list	3 and 6 months



									incorporating role-play of doctor-generated scenarios.		
Butow et al. <sup>43</sup> 2015	Australia	Oncologists working in major cancer centers involved in the treatment of patients with early breast cancer were eligible.	Cancer centers or clinics	41	37%	M=45 years	Over 6 years	RCT	<i>Physician-directed</i> : A 7-h interactive face to- face workshop training with a follow-up telephone call 1 month later. The elements of the training workshop were evidence-based and used accepted adult learning principles.	No intervention	Post-intervention
Garland et al. <sup>45</sup> 2012	Canada	Physicians in intensive care Units	Intensive care units	24	92%	Range 41-60 years	Most over 10 years	Crossover RCT	<i>Organization-directed (focused on workload)</i> : Shift work staffing in which there was 24/7 intensivist presence. The same pool of intensivists supplied dayshift and nightshift coverage. In any given week, a single intensivist was responsible for all seven dayshifts (08:00–17:30, 08:00–15:00 on weekends), whereas two different intensivists alternated the seven nightshifts.	Standard staffing: one intensivist staffed an ICU for 7 days, was present during daytime, and took calls from home at night, returning to ICU as deemed necessary.	Post-intervention

Gunasingam et al. <sup>46</sup> 2015	Australia	Postgraduate year 1 doctors in a single hospital were eligible.	Teaching hospital	31	52%	25 -30 years	M=1 year	RCT	Physician-directed: 3 1-hour debriefing sessions and a focus group involving planning the management of the sessions, discussing the recording sheet to identify themes raised by the participants and agreement for a process if a participant disclosed a serious matter warranting action.	No intervention	2 weeks
Linzer et al. <sup>47</sup> 2015	US	Physicians working within 34 primary care clinics were eligible.	Primary care	135	48%	M=46	M=12 years	Cluster RCT	Organization-directed (focused on communication, teamwork and quality improvement): a) targeted quality improvement (QI) projects; b) communication and changes in workflow	No intervention	12-18 months
Lucas et al. <sup>48</sup> 2012	US	The general medicine inpatient service of a 500-bed public teaching hospital.	General medicine of Hospital	62	52%	M=38	M=4 years	Cluster RCT	Organization-directed (focused on workload or schedule): Assignment to random sequences of 2-week shift rotations.	4-week rotations	1 month
Margalit et al. <sup>49</sup> 2005	Israel	General practitioners randomly selected.	Primary Care	102	n/r	n/r	M=9 years	RCT	Physician-directed: A weekly 4–6 hour workshop for a total of 12 weeks. Interactive	Didactive group	6 months

									teaching intervention aiming to impart the knowledge, attitudes and skills needed for adapting to the task of a physician in a busy community clinic.		
Martins et al. <sup>50</sup> 2011	Argentine	Pediatric residents in a tertiary hospital	Tertiary hospital	74	20%	M=27	Mostly experienced (over 5 years)	RCT	<i>Physician-directed:</i> A brief intervention consisting of two 2.5 hours 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 months
Milstein et al. <sup>51</sup> 2009	US	Pediatric house physicians	Primary care	15	47%	n/r	M=11 Years	RCT	<i>Physician-directed:</i> 45-minute stress reduction intervention where one reflects on the background of the situation that may have generated stress professionally, examines one's affect, or how one feels about a situation, analyses the most troublesome aspects of the situation, individual's expertise, reflects upon	No intervention	3 months

									how one handled the situation, and provides oneself empathy (supportive comments).		
Parshuram et al. <sup>52</sup> 2015	Canada	Physician-Residents in anesthesia, surgery and emergency medicine training programs, who performed in-house overnight duty were eligible.	Intensive care units	47	n/r	n/r	Range= 1-3 years	RCT	<i>Organization-directed (focused on workload or schedule):</i> Residents in 2 university-affiliated Intensive care units were randomly assigned (in 2-month rotation-blocks from January to June 2009) to in-house overnight schedules of 12 hours.	16 and 24 overnight schedules	Post-intervention
Ripp et al. <sup>53</sup> 2014	US	All first year residents in an Internal Medicine Unit were eligible,	Internal Medicine Residence program	51	n/r	n/r	M=1 year	RCT	<i>Physician-directed:</i> 18 one-hour bimonthly practicing physician groups who met regularly with trained discussion group leaders to discuss topics related to stress, balance, and job satisfaction experienced decreased job burnout.	Lunch vouchers	Post-intervention
Shea et al. <sup>54</sup> 2014	US	Graduate internal medicine interns in the Oncology department of Hospital.	Internal medicine a hospital	100	56%	28 years	Range= 1-2 years	RCT	<i>Organization-directed (focused on workload or schedule):</i> a 5-hour period of protected time in which interns were expected to	No intervention	Post-intervention

Verweij et al. <sup>55</sup> 2016	Netherlands	General practitioners affiliated with Dutch training Hospitals were eligible.	Primary Care	50	66%	M=55	M=24 years	Controlled before-after study	sleep (12.30am to 5.30 am) for 4 weeks.  <i>Physician-directed:</i> Eight weekly sessions each lasting 2.5 hours, and a 1-day 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 non-judgmental 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-intervention
Weight et al. <sup>56</sup> 2013		All residents and fellows at Mayo Clinic in Rochester	Secondary care (various specialties) in Mayo clinic	628	59%	M=31	Low experience (59% less than 3 years)	Controlled before-after study	<i>Physician-directed:</i> 12-week, self-directed and team-based incentivized exercise program including self-reported exercise and gym attendance. Participants	No intervention	Post-intervention

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									<p>were encouraged to form teams of 5 for accountability and mutual commitment to exercise. Individual and team points were calculated and e-mailed to participants weekly.</p>		
West et al. <sup>57</sup> 2014	US	Practicing physicians in the Department of Medicine at the Mayo Clinic in Rochester were eligible.	Department of General Medicine	74	65%	n/r	M=8 years	RCT	<p><i>Organization-directed (components from physician-directed interventions):</i> The intervention involved facilitated physician small-group curriculum: 19 biweekly facilitated physician discussion groups incorporating elements of mindfulness, reflection, shared experience, and small-group learning for 9 months. Protected time (1 hour of paid time every other week) for participants was provided by the institution.</p>	No intervention	3 & 12 months

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M= mean, RCT= randomized controlled trial; n/a= not available; n/r= not reported