

# This article has been retracted

JAMA Internal Medicine | [Original Investigation](#) | [PHYSICIAN WORK ENVIRONMENT AND WELL-BEING](#)

## Association Between Physician Burnout and Patient Safety, Professionalism, and Patient Satisfaction A Systematic Review and Meta-analysis

Maria Panagioti, PhD; Keith Geraghty, PhD; Judith Johnson, PhD; Anli Zhou, MD; Efharis Panagopoulou, PhD; Carolyn Chew-Graham, MD; David Peters, MD; Alexander Hodgkinson, PhD; Ruth Riley, PhD; Aneez Esmail, MD, PhD

**IMPORTANCE** Physician burnout has taken the form of an epidemic that may affect core domains of health care delivery, including patient safety, quality of care, and patient satisfaction. However, this evidence has not been systematically quantified.

**OBJECTIVE** To examine whether physician burnout is associated with an increased risk of patient safety incidents, suboptimal care outcomes due to low professionalism, and lower patient satisfaction.

**DATA SOURCES** MEDLINE, Embase, PsycInfo, and CINAHL databases were searched until October 22, 2017, using combinations of the key terms *physicians*, *burnout*, and *patient care*. Detailed standardized searches with no language restriction were undertaken. The reference lists of eligible studies and other relevant systematic reviews were hand-searched.

**STUDY SELECTION** Quantitative observational studies.


**DATA EXTRACTION AND SYNTHESIS** Two independent reviewers were involved. The main meta-analysis was followed by subgroup and sensitivity analyses. All analyses were performed using random-effects models. Formal tests for heterogeneity ( $I^2$ ) and publication bias were performed.

**MAIN OUTCOMES AND MEASURES** The core outcomes were the quantitative associations between burnout and patient safety, professionalism, and patient satisfaction reported as odds ratios (ORs) with their 95% CIs.

**RESULTS** Of the 5234 records identified, 47 studies on 42 473 physicians (25 059 [59.0%] men; median age, 38 years [range, 27-53 years]) were included in the meta-analysis. Physician burnout was associated with an increased risk of patient safety incidents (OR, 1.96; 95% CI, 1.59-2.40), poorer quality of care due to low professionalism (OR, 2.31; 95% CI, 1.87-2.85), and reduced patient satisfaction (OR, 2.28; 95% CI, 1.42-3.68). The heterogeneity was high and the study quality was low to moderate. The links between burnout and low professionalism were larger in residents and early-career ( $\leq 5$  years post residency) physicians compared with middle- and late-career physicians (Cohen  $Q = 7.27$ ;  $P = .003$ ). The reporting method of patient safety incidents and professionalism (physician-reported vs system-recorded) significantly influenced the main results (Cohen  $Q = 8.14$ ;  $P = .007$ ).

**CONCLUSIONS AND RELEVANCE** This meta-analysis provides evidence that physician burnout may jeopardize patient care; reversal of this risk has to be viewed as a fundamental health care policy goal across the globe. Health care organizations are encouraged to invest in efforts to improve physician wellness, particularly for early-career physicians. The methods of recording patient care quality and safety outcomes require improvements to concisely capture the outcome of burnout on the performance of health care organizations.

JAMA Intern Med. 2018;178(10):1317-1330. doi:10.1001/jamainternmed.2018.3713  
Published online September 4, 2018. Retracted on March 18, 2020.

 [Invited Commentary](#)  
page 1331

 [Supplemental content](#)

**Author Affiliations:** Author affiliations are listed at the end of this article.

**Corresponding Author:** Maria Panagioti, PhD, National Institute for Health Research (NIHR) School for Primary Care Research, NIHR Greater Manchester Patient Safety Translational Research Centre, Manchester Academic Health Science Centre, University of Manchester, Williamson Building, Oxford Road, Manchester M13 9PL, United Kingdom (maria.panagioti@manchester.ac.uk).

# This article has been retracted

The view that physician wellness is an indicator of the quality of health care organizations is not new—the concept was introduced decades ago and has since gained increasing support.<sup>1–4</sup> The most well-known inverse metric of physician wellness is burnout, defined as a response to prolonged exposure to occupational stress encompassing feelings of emotional exhaustion, depersonalization, and reduced professional efficacy.<sup>5</sup> There is evidence that the prevalence of burnout in physicians is high and that its result on the personal lives of physicians is profound.<sup>6</sup> The 2017 Medscape Physician Lifestyle Report suggests that 50% of physicians in the United States report signs of burnout, representing a rise of 4% within a year.<sup>7</sup> Burnout is associated with increased risk for cardiovascular disease and shorter life expectancy, problematic alcohol use, broken relationships, depression, and suicide.<sup>8,9</sup>

Despite consistent findings regarding the high prevalence of burnout and the detrimental personal consequences for physicians, research evidence about the outcome of physician burnout on the quality of care delivered to patients is less definitive. A number of empirical studies have found that physicians with burnout are more likely to be involved in patient safety incidents,<sup>8</sup> fail on critical aspects of professionalism that determine the quality of patient care (eg, adherence to treatment guidelines, quality of communication, and empathy), and receive lower patient satisfaction ratings.<sup>10</sup> Moreover, 2 recent systematic reviews have associated high burnout in health care professionals with the receipt of less-safe patient care.<sup>11,12</sup> However, these reviews have significant limitations. One included heterogeneous samples of health care professionals rather than physicians in particular, making quantification of these links using meta-analysis risky<sup>12</sup>; the second focused on a limited number of studies.<sup>11</sup> Both systematic reviews failed to explore complementary dimensions of patient safety, such as suboptimal care outcomes resulting from low professionalism and patient satisfaction, and neither used meta-analysis to quantify the strength of the associations.<sup>11</sup>

In this systematic review, we examined whether physician burnout is associated with lower quality of patient care focusing on (1) patient safety incidents, (2) suboptimal care outcomes resulting from low professionalism, and (3) lower patient satisfaction. We also evaluated the influence of key sources of heterogeneity on these associations, including the health care setting in which physicians are working and the reporting method of patient care outcomes (physician reported, patient reported, or system recorded). This study is essential to acquire a holistic understanding of the association between physician burnout and health care service delivery and confirm the need for dynamic organization-wide resolutions to mitigate burnout.

## Methods

This systematic review was conducted and reported in accordance with the Reporting Checklist for Meta-analyses of Observational Studies (MOOSE)<sup>13</sup> and Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)

## Key Points

**Question** Is physician burnout associated with low-quality, unsafe patient care?

**Findings** This meta-analysis of 47 studies on 42 473 physicians found that burnout is associated with 2-fold increased odds for unsafe care, unprofessional behaviors, and low patient satisfaction. The depersonalization dimension of burnout had the strongest links with these outcomes; the association between unprofessionalism and burnout was particularly high across studies of early-career physicians.

**Meaning** Physician burnout is associated with suboptimal patient care and professional inefficiencies; health care organizations have a duty to jointly improve these core and complementary facets of their function.

guidance.<sup>14</sup> The completed MOOSE checklist is available in eTable 1 in the Supplement.

## Searches

MEDLINE, PsycInfo, Embase, and CINAHL were searched until October 22, 2017. The searches included combinations of 3 key blocks of terms (*physicians, burnout, patient care*) involving Medical Subject Headings terms and text words (eTable 2 in the Supplement). Relevant systematic reviews and the reference lists of the eligible studies were hand-searched; there were no language restrictions.

## Eligibility Criteria

Physicians working in any health care setting were eligible for inclusion. Any quantitative study reporting data on the association between physician burnout and patient safety were eligible.

Burnout was the primary outcome evaluated with standardized measures, such as the Maslach Burnout Inventory (MBI) or equivalent. The MBI assesses the 3 dimensions of the burnout experience, including emotional exhaustion, depersonalization, and personal accomplishment, and produces separate scores for each dimension.<sup>15</sup> We also included studies reporting measures of depression and emotional distress, as these are closely related to burnout, but these outcomes were analyzed separately.<sup>16</sup>

Patient safety incidents were defined as “any unintended events or hazardous conditions resulting from the process of care, rather than due to the patient’s underlying disease, that led or could have led to unintended health consequences for the patient or health care processes associated with safety outcomes.”<sup>17(p9)</sup> Examples of patient safety incidents are adverse events, adverse drug events, or other therapeutic and diagnostic incidents.

Professionalism operationalized was based on Stern’s 4 core principles: excellence, accountability, altruism, and humanism.<sup>18</sup> As indicators of low professionalism, we included suboptimal adherence to treatment guidelines (eg, US Preventive Services Task Force guidelines on prescription of recommended treatments and medications, test-ordering practices, referrals to treatment or other services, and discharge),

# This article has been retracted

reduced professional integrity (eg, malpractice claims), poor communication practices (eg, provision of suboptimal information to patients), and low empathy. We viewed reduced professionalism as an indicator of suboptimal quality of care and a precursor of patient safety incidents<sup>19</sup> because it involves some type of omission or commission error with potential to result in a patient safety incident. Patient satisfaction was based on patient-reported measures, such as satisfaction and perceived enablement scores.

Data to allow the computation of an effect size in each study were sought. We extracted these data from the published reports where available, and we contacted the lead authors of studies that did not report sufficient data to compute an effect size (ie, reported only *P* values).

Gray literature (eg, unpublished conference presentations, theses, government reports, and policy statements) was excluded. We also excluded studies that reported generic health outcomes, such as quality of life, overall well-being, or resilience.

## Data Selection, Extraction, and Critical Appraisal

The results of the searches were exported into EndNote (Clarivate Analytics). After removal of duplicates, a 2-stage selection process was followed. At stage 1, titles and abstracts of studies were screened for relevance. At stage 2, full texts of studies ranked as relevant in stage 1 were accessed and fully screened against the eligibility criteria. A standardized Excel data extraction spreadsheet (Microsoft Inc) was devised to facilitate the extraction of (1) descriptive data from the studies, including study characteristics (eg, design and setting), participant characteristics (eg, age, sex) and main outcome measures (physician burnout measure, indicators of suboptimal care), and (2) quantitative data for computing effect sizes in each study. The data extraction spreadsheet was piloted in 5 randomly selected studies before use. We used 3 widely used fundamental criteria adapted from guidance on the assessment of observational studies (cross-sectional and cohort studies)<sup>20</sup>: (1) a response rate of 70% or greater at baseline (yes, 1; no/unclear, 0), (2) control for confounding factors in analysis (yes, 1; no/unclear, 0), and (3) study design (longitudinal, 1; cross-sectional, 0).

Ratings were not used to exclude articles prior to synthesis but to provide a context for assessing the validity of the findings (eg, sensitivity analyses). Screening, data extraction, and the critical appraisal were independently undertaken by 2 reviewers (M.P. and K.G.). The interrater agreement was high ( $\kappa$  coefficients, 0.91, 0.89, and 0.88, respectively). Any disagreements were resolved by discussion and the involvement of a third reviewer.

## Statistical Analysis

The primary outcome was the association of burnout (overall burnout, emotional exhaustion, depersonalization, and personal accomplishment) with suboptimal patient care indicators (patient safety incidents, professionalism, and patient satisfaction). Secondary outcomes were depression and emotional distress with suboptimal patient care. Odds ratios (ORs) together with 95% CIs were calculated for all primary and

secondary outcomes in each study. Studies were eligible for inclusion in more than 1 analysis (eg, if they reported all 3 dimensions of burnout and/or >1 suboptimal patient care outcome), but none of the studies is represented twice in the same analysis to avoid double counting. Odds ratios were typically computed from dichotomous data (number/rates of safety incidents), but continuous data (ie, means) were also converted to ORs using appropriate methods proposed in the *Cochrane Handbook*.<sup>21</sup> An OR greater than 1 indicates that burnout is associated with increased risk of suboptimal patient care outcomes, whereas an OR less than 1 indicates that burnout is associated with reduced risk for suboptimal patient care outcomes. Owing to high heterogeneity, random-effects models were applied to calculate pooled ORs in all analyses.<sup>22,23</sup>

Heterogeneity was assessed using the  $I^2$  statistic, with values of 25%, 50%, and 75% indicating low, moderate, and high heterogeneity, respectively.<sup>24</sup> A sensitivity analysis was performed to evaluate the stability of the results when only studies less susceptible to risk of bias were retained in the analysis. One prespecified subgroup analysis explored whether the main findings were influenced by the reporting method of patient care outcomes (physician reported, system based). We also conducted 2 post hoc subgroup analyses to examine whether the geographic region of the studies (US vs non-US studies) and the career stage of physicians (residents/early career vs middle/late career) influenced the main findings. We inspected the symmetry of the funnel plots and performed the Egger test to examine for publication bias.<sup>25</sup> All meta-analyses were performed in Stata, version 14 (StataCorp) using the metaan command.<sup>26</sup> Funnel plots were constructed using the metafunnel command,<sup>27</sup> and the Egger test was computed using the metabias command.<sup>28</sup>

## Results

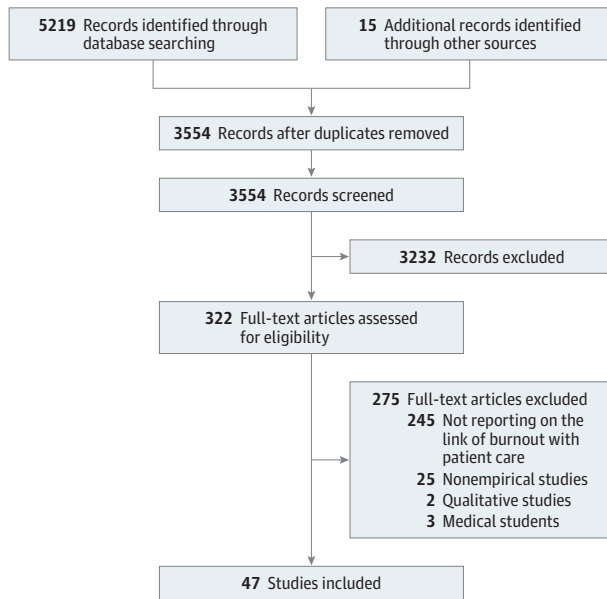
We identified 5234 records and, following the removal of duplicates, we screened 3554 titles and abstracts for eligibility in this review. After screening, 47 studies met our inclusion criteria.<sup>4,8,10,22,23,29-70</sup> The flowchart of the study selection process is presented in **Figure 1**.

## Descriptive Characteristics of the Included Studies

Descriptive details of the eligible studies are presented in the **Table**. Across all 47 studies, a pooled cohort of 42 473 physicians was formed. The median number of recruited physicians was 243 (range, 24-7926; 25 059 [59.0%] men). Median age of the physicians was 38 years (range, 27-53 years). Our pooled cohort consisted of physicians at different stages of their career; 21 studies were primarily based on residents and early-career ( $\leq 5$  years post residency) physicians (44.7%) and 26 considered experienced physicians (55.3%). Thirty studies were based on hospital physicians (63.8%), 13 studies were based on primary care physicians (27.7%), and 4 were based on mixed samples of physicians across any health care setting (8.5%). Thirty-seven studies were cross-sectional (78.7%) and 10 were prospective cohort studies (21.3%). Twenty-three of the stud-

# This article has been retracted

Figure 1. PRISMA Flowchart



Flowchart of the inclusion of studies in the review.

ies were conducted in the United States (48.9%), 15 in Europe (31.9%), and 9 elsewhere (19.1%).

All studies used validated measures of physician burnout. The Maslach Burnout Inventory (the original or revised iterations) was the most common measure of burnout (41 of 43 studies that reported data on burnout [87.2%]).<sup>5</sup> Fourteen studies reported secondary measures of depression and emotional distress, which were analyzed separately. Twenty-one studies reported patient safety incidents, 28 reported indicators of low professionalism, and 7 studies reported measures of patient satisfaction. Nine studies reported more than 1 of these outcomes. Patient safety incidents and suboptimal patient care due to low professionalism were assessed based on physician self-reports across the majority of the studies (17 of 21 [81.0%] and 22 of 29 [75.9%] studies, respectively), whereas the remaining used patient record reviews and surveillance systems. Patient satisfaction was based on self-reports by patients.

Nineteen studies reported a response rate of 70% or greater at baseline (40.4% met criterion 1), 36 studies adjusted for confounders in the analyses (76.6% met criterion 2), and 10 studies were prospective cohorts (21.3% met criterion 3). In total, 20 (42.6%) studies met at least 2 of the 3 quality criteria, whereas only 5 studies (10.6%) met all 3 criteria. The results of the critical appraisal assessment are presented in eTable 3 in the Supplement.

## Main Meta-analyses

### Burnout and Patient Safety Incidents

The pooled outcomes of the main analysis indicated that physician overall burnout is associated with twice the odds of involvement in patient safety incidents (OR, 1.96; 95% CI, 1.59-2.40;  $I^2 = 97.7\%$ ) (Figure 2). All dimensions of burnout were

associated with significantly increased odds of involvement in patient safety incidents (emotional exhaustion: OR, 1.73; 95% CI, 1.43-2.08;  $I^2 = 97.3\%$ ; depersonalization: OR, 1.94; 95% CI, 1.29-2.90;  $I^2 = 99.3\%$ ; personal accomplishment: OR, 1.49; 95% CI, 1.23-1.81;  $I^2 = 96.4\%$ ). The heterogeneity across all analyses was moderate to high in most analyses as indicated by the  $I^2$  values.

Symptoms of depression/emotional distress in physicians were associated with a 2-fold increased risk of involvement in patient safety incidents (OR, 2.38; 95% CI, 1.84-2.92;  $I^2 = 74\%$ ) (eFigure 1 in the Supplement).

### Burnout and Professionalism

Overall burnout in physicians was associated with twice the odds of exhibiting low professionalism (OR, 2.31; 95% CI, 1.87-2.85;  $I^2 = 89.5\%$ ) (Figure 3). Particularly, depersonalization was associated with a 3-fold increased risk for reporting low professionalism (OR, 3.00; 95% CI, 2.02-4.43;  $I^2 = 93.6\%$ ;  $P < .001$ ). Emotional exhaustion and reduced personal accomplishment were associated with over 2.5-fold increased odds for low professionalism (OR, 2.71; 95% CI, 1.91-3.86;  $I^2 = 89.6\%$ ; OR, 2.49; 95% CI, 1.69-3.67;  $I^2 = 89.7\%$ ). Symptoms of depression or emotional distress were associated with 1.5 times increased risk for low professionalism (OR, 1.68; 95% CI, 1.44-1.92;  $I^2 = 61\%$ ) (eFigure 2 in the Supplement).

### Burnout and Patient Satisfaction

Overall burnout in physicians was associated with a 2-fold increased odds for low patient-reported satisfaction (OR, 2.28; 95% CI, 1.42-3.68;  $I^2 = 90.5\%$ ) (Figure 4). Particularly, depersonalization was associated with 4.5-fold increased odds for low patient-reported satisfaction (OR, 4.50; 95% CI, 2.34-8.64;  $I^2 = 91.6\%$ ). Personal accomplishment was also associated with over 2-fold increased odds for low patient-reported satisfaction (OR, 1.94; 95% CI, 1.25-3.01;  $I^2 = 72.2\%$ ), whereas emotional exhaustion was not significantly associated with patient-reported satisfaction (OR, 2.35; 95% CI, 0.83-6.64;  $I^2 = 96.6\%$ ).

### Small-Study Bias

No substantial funnel plot asymmetry was observed in the main analyses. The Egger test indicated that the results were not influenced by publication bias (Egger test  $P = .07$ ) (eFigure 3 in the Supplement).

### Sensitivity Analysis

The pooled outcome sizes indicating an association derived by the studies with higher-quality scores (studies that met 2 of the 3 criteria) were similar to the pooled outcome sizes of the main analyses (overall burnout and safety incidents: OR, 1.93; 95% CI, 1.45-2.41; overall burnout and professionalism: OR, 2.32; 95% CI, 1.66-2.98).

## Subgroup Analyses

### Reporting Method of Patient Care Outcomes

Burnout was associated with twice the risk of physician-reported safety incidents and low professionalism (OR, 2.07; 95% CI, 2.03-2.11;  $I^2 = 65\%$ ; OR, 2.67; 95% CI,

This article has been retracted

Table. Descriptive Characteristics of Included Studies											
Source	Healthcare Setting	Research Design	No.	Men, %	Mean Age, y	Burnout Measure	Depression/Distress Measure	Patient Safety	Professionalism	Patient Satisfaction	Risk of Bias
Anagnostopoulos et al, <sup>10</sup> 2012, Greece	Physicians in 3 large primary care centers	Cross-sectional	30	85	48	MBI	NR	NR	NR	Patient satisfaction	2
Asai et al, <sup>29</sup> 2007, United States	Physicians in life care (hospitals and cancer centers)	Cross-sectional	697	92	45	MBI	General health questionnaire	NR	Self-reported nonoptimal communication	NR	1
Baer et al, <sup>30</sup> 2017, United States	Residents in 11 pediatric residency programs	Cross-sectional	258	21	29	2 Items from MBI	NR	Self-reported medical errors	Self-reported nonoptimal communication	NR	1
Balch et al, <sup>31</sup> 2011, United States	Surgeons, members of the American College of Surgeons (hospitals)	Cross-sectional	7164	85	53	MBI	2-Item primary care evaluation of mental disorders	NR	Self-reported malpractice claims	NR	1
Bourne et al, <sup>32</sup> 2015, United Kingdom	Physicians registered to the British Medical Association	Cross-sectional	7926	54	NR	NR	General health questionnaire	NR	Self-reported patient complaints	NR	0
Brazeau et al, <sup>33</sup> 2010, United States	Faculty and resident physicians in 1 hospital	Cross-sectional	125	52	NR	MBI	NR	NR	Self-reported professionalism	NR	2
Brown et al, <sup>34</sup> 2009, Australia	Interns or residents in 1 hospital	Cross-sectional	24	60	42	MBI	NR	NR	Self-reported nonoptimal communication	NR	1
Chen et al, <sup>35</sup> 2013, Taiwan	Physicians registered at several medical associations	Cross-sectional	839	79	36	MBI	NR	NR	Self-reported malpractice claims	NR	2
Cooke et al, <sup>36</sup> 2013, Australia	General practitioners in primary care	Cross-sectional	128	33	35	1 Item for emotional exhaustion subscale of MBI	NR	NR	Self-reported nonoptimal communication	NR	1
de Oliveira et al, <sup>37</sup> 2013, United States	Anesthesiology residents in hospitals	Cross-sectional	1508	54	NR	MBI	NR	Self-reported medical errors	Self-reported safety practice scores	NR	1
Dollarhide et al, <sup>22</sup> 2014, United States	Physicians in 4 hospitals	Cross-sectional	185	46	30	NR	Emotional stress using the Diary of Ambulatory Behavioral States	Self-reported medication errors	NR	NR	1
Eckleberry-Hunt et al, <sup>23</sup> 2017, United States	Physicians registered in American Academy of Family Physicians	Cross-sectional	449	54	42	MBI	NR	NR	Self-reported quality of patient care	NR	1
Fahrenkopf et al, <sup>38</sup> 2008, United States	Residents in pediatric residency hospitals	Prospective	123	30	NR	MBI	Harvard Depression Scale	Medication errors identified by surveillance	NR	NR	1
Garrouste-Orgeas et al, <sup>39</sup> 2015, France	Physicians in 31 intensive care units	Prospective	540	58	33	MBI	CES-Depression Scale	Self-reported medical errors	NR	NR	3
Halbesleben and Rathert, <sup>40</sup> 2008, United States	Primary care physicians of hospitalized patients in 1 hospital	Cross-sectional	178	47	46	MBI	NR	NR	NR	Patient satisfaction	1
Hansen et al, <sup>41</sup> 2011, Denmark	Primary care physicians of a national cohort of cancer patients	Cross-sectional	334	70	NR	MBI	NR	Delayed cancer diagnosis based on patient records	NR	NR	2

(continued)



This article has been retracted

Table. Descriptive Characteristics of Included Studies (continued)

Source	Healthcare Setting	Research Design	No.	Men, %	Mean Age, y	Burnout Measure	Depression/Distress Measure	Patient Safety	Professionalism	Patient Satisfaction	Risk of Bias
Hayashino et al, <sup>42</sup> 2012, Japan	Physicians based in hospitals approached by a national survey	Prospective	836	92	46	MBI	WHO Depression Index	Self-reported medical errors	NR	NR	3
Kalmbach et al, <sup>43</sup> 2017, United States	Physicians of several specialties in 33 hospitals	Prospective	1215	31	28	NR	Patient Health Questionnaire-9	Self-reported medical errors	NR	NR	3
Kang et al, <sup>44</sup> 2013, Korea	Interns and residents working at 1 university hospital	Cross-sectional	86	74	NR	MBI	2-Item Primary Care Evaluation Of Mental Disorders	Self-reported medical errors	NR	NR	1
Klein et al, <sup>45</sup> 2010, Germany	Surgeons in general hospitals	Cross-sectional	1311	60	NR	Copenhagen Burnout Inventory	NR	Self-reported therapeutic errors	Self-reported quality of patient care	NR	1
Krebs et al, <sup>46</sup> 2006, United States	Primary care physicians responded to the Physician Worklife Survey	Cross-sectional	1391	77	47	NR	One 5-point Likert Scale for Depression	NR	Self-reported non-optimal communication	NR	1
Kwah et al, <sup>47</sup> 2016, United States	First-year residents at 1 hospital	Prospective	54	50	32	MBI	NR	Prescription errors in system records	Professionalism (discharge practices)	NR	2
Lafraniere et al, <sup>48</sup> 2016, United States	Internal medicine residents at 1 large urban academic hospital	Cross-sectional	44	43	51	MBI	NR	NR	NR	Patient-reported empathy	2
Linzer et al, <sup>49</sup> 2009, United States	General internists and family physicians in 119 ambulatory clinics	Cross-sectional	422	56	43	Single item measure validated against MBI	NR	Medical errors in system records	Quality of patient care (using system indicators)	NR	1
Lu et al, <sup>50</sup> 2015, United States	Attending and postgraduate physicians in emergency department	Cross-sectional	77	62	NR	MBI	NR	Self-reported treatment errors	Self-reported professionalism (discharge practices)	NR	0
O'Connor et al, <sup>51</sup> 2017, Ireland	Interns at 5 national intern training hospitals	Prospective	172	44	27	MBI	NR	Self-reported medical errors	NR	NR	2
Ožvačić Adžić et al, <sup>52</sup> 2013, Croatia	Physicians working in family practices selected randomly using a multistage, stratified proportional study selection design	Cross-sectional	125	18	46	MBI	NR	NR	Professionalism (consultation length)	Patient-reported enablement	0
Park et al, <sup>53</sup> 2016, Korea	Physicians at 4 university hospitals	Cross-sectional	317	68	30	MBI	NR	NR	Self-reported empathy	NR	0
Passalacqua and Segrin, <sup>54</sup> 2012, United States	Residents in internal medicine rotating between 3 hospitals	Cross-sectional	93	70	30	MBI	NR	NR	Self-reported nonoptimal communication	NR	0
Pedersen et al, <sup>55</sup> 2015, Denmark	General practitioners registered in Regional Registry of Health Providers	Cross-sectional	129	100	49	MBI	NR	NR	Professionalism (test practices)	NR	2
Prins et al, <sup>56</sup> 2009, the Netherlands	Residents receiving training for a referral specialty	Cross-sectional	2115	39	32	MBI	NR	Self-reported action errors	NR	NR	1

(continued)

## This article has been retracted

Table. Descriptive Characteristics of Included Studies (continued)

Source	Healthcare Setting	Research Design	No.	Men, %	Mean Age, y	Burnout Measure	Depression/Distress Measure	Patient Safety	Professionalism	Patient Satisfaction	Risk of Bias
Qureshi et al, <sup>57</sup> 2015, United States	Plastic surgeons members of the American Society of Plastic Surgeons	Cross-sectional	1691	75	51	MBI	NR	Self-reported medical errors	NR	NR	2
Ratanawongsa et al, <sup>58</sup> 2008, United States	Physicians in 5 primary care practices	Prospective	40	34	42	6-Item scale derived from MBI	NR	NR	Self-reported empathy	Patient satisfaction	2
Shanafelt et al, <sup>4</sup> 2002, United States	Residents in the University of Washington Affiliated Hospitals Internal Medicine Residency program	Cross-sectional	83	70	NR	MBI	NR	NR	Self-reported quality of patient care	NR	2
Shanafelt et al, <sup>59</sup> 2005, United States	Internal medicine residents at Mayo Clinic Rochester	Cross-sectional	115	70	NR	MBI	NR	NR	Self-reported empathy	NR	2
Shanafelt et al, <sup>8</sup> 2010, United States	Surgeons, members of the American College of Surgeons	Cross-sectional	7905	87	51	MBI	2-Item Primary Care Evaluation of Mental Disorders	Self-reported medical errors	NR	NR	2
Toral-Villanueva et al, <sup>60</sup> 2009, Mexico	Junior physicians in 3 hospitals	Cross-sectional	312	57	28	MBI	NR	NR	Self-reported quality of patient care	NR	1
Yuguero Torres et al, <sup>61</sup> 2015, Spain	Physicians in 22 primary care centers	Cross-sectional	108	46	49	MBI	NR	NR	Professionalism (system-recorded sick leave)	NR	0
Travado et al, <sup>62</sup> 2005, Italy	Physicians in cancer centers of 3 hospitals	Cross-sectional	125	46	42	MBI	NR	NR	Self-reported nonoptimal communication	NR	1
van den Hombergh et al, <sup>63</sup> 2009, the Netherlands	General practitioners in 239 general practices	Cross-sectional	546	61	47	General practitioner burnout involving experience of inappropriate patient demands, commitment with the job, excessive workload	NR	NR	Self-reported quality of patient care	Patient satisfaction	1
Walocha et al, <sup>64</sup> 2013, Poland	Physicians working in surgical and nonsurgical hospital wards and primary care outpatient departments	Cross-sectional	71	64	NR	MBI	NR	NR	Self-reported empathy	NR	0
Weigl et al, <sup>65</sup> 2015, Germany	Physicians in 1 pediatric hospital	Cross-sectional	96	47	38	MBI	NR	NR	Self-reported quality of patient care	NR	2
Welp et al, <sup>66</sup> 2015, Switzerland	Physicians in intensive care units	Cross-sectional	243	50	39	MBI	NR	Self-reported safety errors	NR	NR	1
Wen et al, <sup>67</sup> 2016, China	Physicians in 44 hospitals providing tertiary and secondary care, and 25 primary care	Cross-sectional	1537	56	38	MBI	NR	Self-reported medical errors	NR	NR	2

(continued)

# This article has been retracted

Table. Descriptive Characteristics of Included Studies (continued)

Source	Healthcare Setting	Research Design	No.	Men, %	Mean Age, y	Burnout Measure	Depression/Distress Measure	Patient Safety	Professionalism	Patient Satisfaction	Risk of Bias
Weng et al, <sup>68</sup> 2011, Taiwan	Internists at 2 hospitals	Cross-sectional	110	85	41	MBI	NR	NR	NR	Patient satisfaction	1
West et al, <sup>69</sup> 2006, United States	Internal medicine residency program in Mayo Clinic in academic years 2003-2006	Prospective	184	51	NR	MBI	2-Item Primary Care Evaluation of Mental Disorders	Self-reported medical errors	NR	NR	3
West et al, <sup>70</sup> 2009, United States	Internal medicine residency program at Mayo Clinic between July 2003 and February 2009	Prospective	380	62	NR	MBI	2-Item Primary Care Evaluation of Mental Disorders	Self-reported medical errors	NR	NR	3

Abbreviations: CES, Center for Epidemiological Studies; MBI, Maslach Burnout Inventory; NR, not reported; WHO, World Health Organization.

2.19-3.15;  $I^2 = 56\%$ , respectively), whereas the association between physician burnout and system-recorded safety incidents and low professionalism was statistically nonsignificant or marginally significant (OR, 1.00; 95% CI, 0.81-1.18;  $I^2 = 15\%$ ; OR, 1.15; 95% CI, 1.02-1.31;  $I^2 = 10\%$ , respectively). Both subgroup differences were statistically significant (Cohen  $Q = 8.14$  and  $7.78$ ;  $P = .007$ ).

### Country of Origin

The pooled associations of physician burnout with patient safety incidents and low professionalism did not differ significantly across studies based on US physicians (OR, 1.69; 95% CI, 1.46-1.92;  $I^2 = 71\%$ ; OR, 2.02; 95% CI, 1.59-2.44;  $I^2 = 75\%$ , respectively) and studies based on physicians in other countries (OR, 1.96; 95% CI, 1.62-2.30;  $I^2 = 82\%$ ; OR, 1.97; 95% CI, 1.57-2.38;  $I^2 = 87\%$ , respectively). The Cohen  $Q$  tests for both analyses were statistically nonsignificant.

### Career Stage of Physicians

The pooled association of burnout with patient safety incidents did not differ significantly across studies based on residents and early-career physicians and studies based on middle- and late-career physicians (OR, 1.73; 95% CI, 1.46-2.00;  $I^2 = 79\%$  vs OR, 1.87; 95% CI, 1.49-2.25;  $I^2 = 76\%$  respectively; Cohen  $Q = 1.32$ ;  $P = .17$ ). However, the pooled association of burnout with low professionalism was significantly larger across studies based on residents and early-career physicians, compared with studies based on middle- and late-career physicians (OR, 3.39; 95% CI, 2.38-4.40;  $I^2 = 23\%$  vs OR, 1.73, 95% CI, 1.46-2.01;  $I^2 = 67\%$ , respectively; Cohen  $Q = 7.27$ ;  $P = .003$ ).

## Discussion

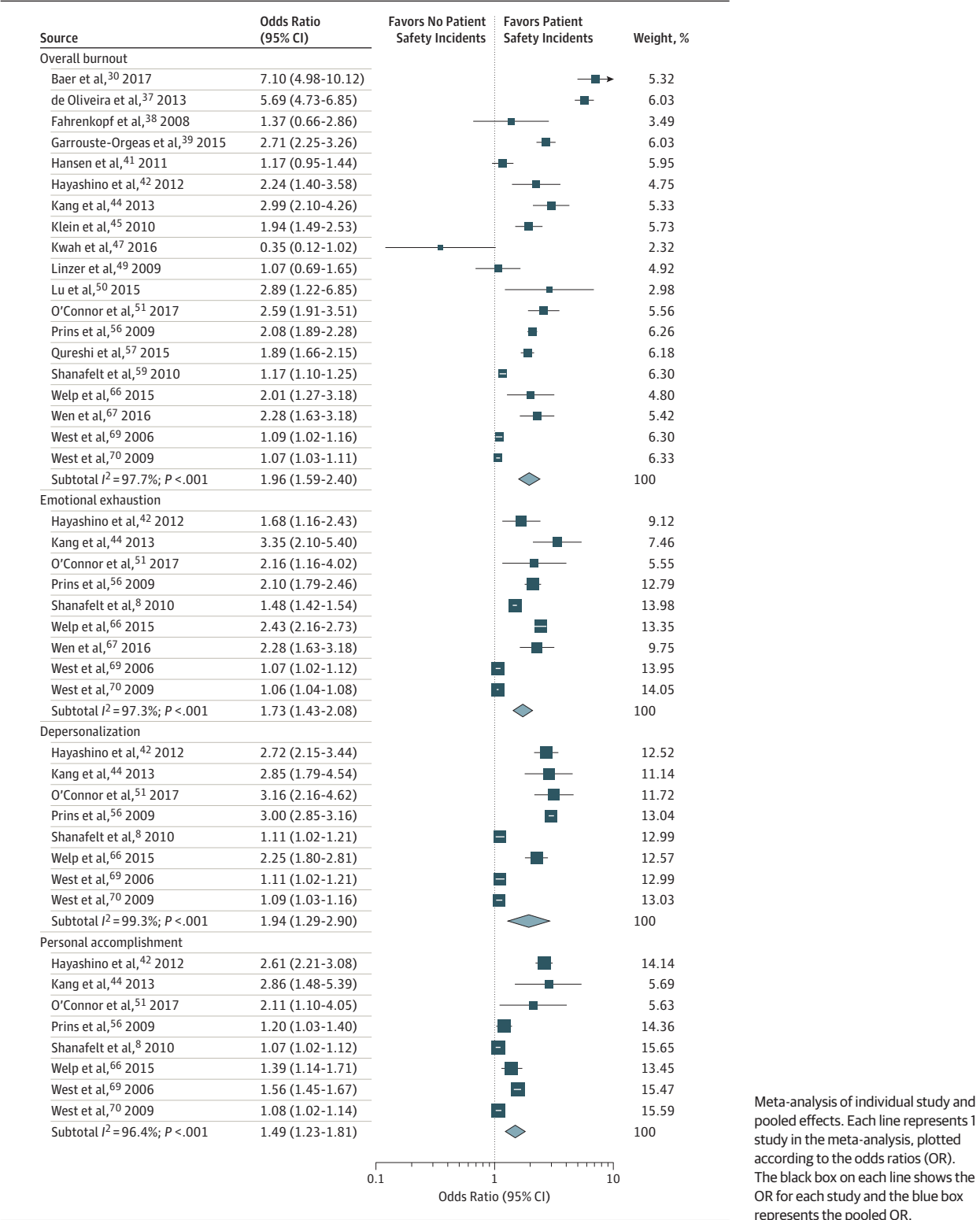
This systematic review and meta-analysis provides robust quantitative evidence that physician burnout is associated with suboptimal patient care in the process of health care service delivery. We found that physicians with burnout are twice as likely to be involved in patient safety incidents, twice as likely to deliver suboptimal care to patients owing to low professionalism, and 3 times more likely to receive low satisfaction ratings from patients. The depersonalization dimension of burnout appears to have the most adverse association with the quality and safety of patient care and with patient satisfaction. The association of burnout with low professionalism was particularly strong among studies based on residents and early-career physicians. The reporting method of patient safety incidents and professionalism had a significant influence on the results, suggesting that improved assessment standards for patient safety and professionalism are needed in the health care field.

Two previous systematic reviews have associated burnout in health care professionals with patient safety outcomes.<sup>11,12</sup> In the present review, we undertook a meta-analysis, enabling the quantification of these links and the exploration of key sources of heterogeneity among the studies. We focused on physicians but established links between burnout/stress and a wider range of patient care indicators,



This article has been retracted

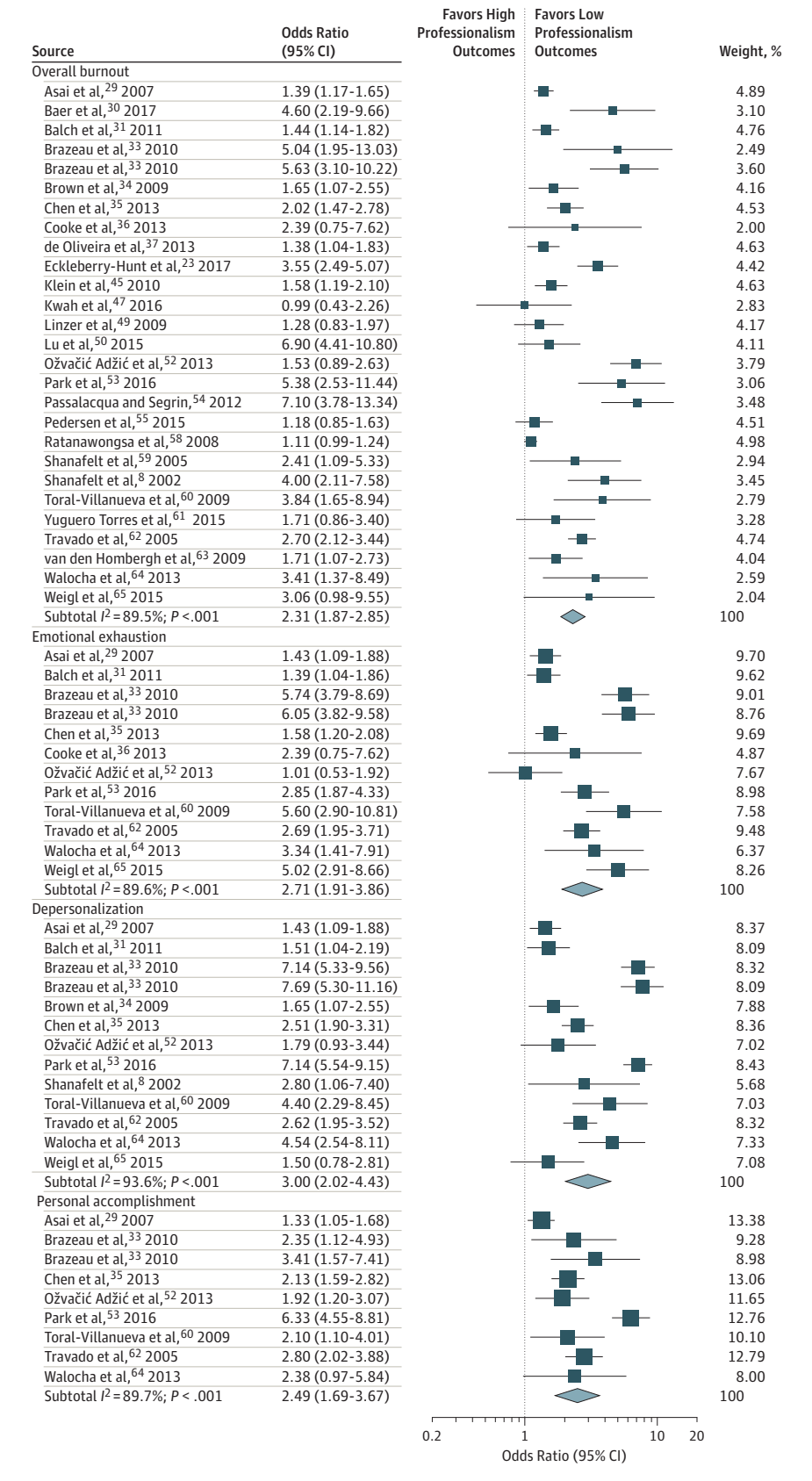
Figure 2. Association Between Physician Burnout and Patient Safety Incidents



including patient safety incidents, low professionalism, and patient satisfaction. We chose to focus on physicians because the function of any health care system primarily relies on physicians, but evidence suggests that physicians are 2 times more likely to experience burnout than any other workers, including other health care professionals.<sup>1,6,71</sup> We thought it is critical, therefore, to better understand the association between physician burnout and patient safety, professionalism, and patient satisfaction. We chose to investigate a wider range of patient care indicators because, although professionalism and patient

# This article has been retracted

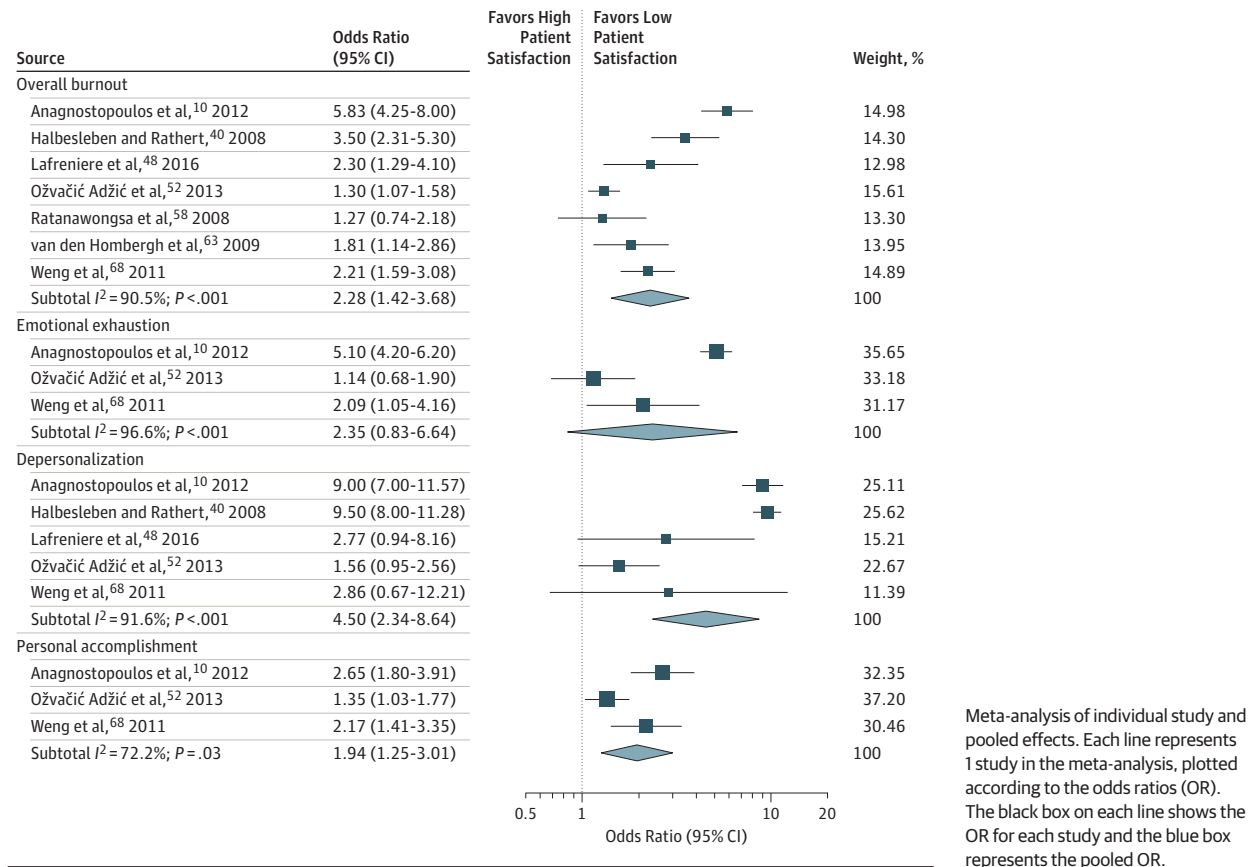
Figure 3. Forest Plot of the Association Between Physician Burnout and Low Professionalism Outcomes



Meta-analysis of individual study and pooled effects. Each line represents 1 study in the meta-analysis, plotted according to the odds ratios (OR). The black box on each line shows the OR for each study and the blue box represents the pooled OR.

# This article has been retracted

Figure 4. Association Between Physician Burnout and Reduced Patient Satisfaction



satisfaction are precursors of safety risks with potential to lead to active patient safety incidents,<sup>19</sup> to our knowledge, previous research has not systematically reviewed the association between burnout/stress and these outcomes. Moreover, aspects of professionalism, such as poor empathy and suboptimal patient-physician rapport, could result in underinvestigated but important adversities for patients, such as psychological harm and an overall negative experience of health care.

We found that physician burnout is associated with a reduced efficiency of health care systems to deliver high-quality, safe care to patients. Preventable adverse events cost several billions of dollars to health care systems every year.<sup>72</sup> Physician burnout therefore is costly for health care organizations and undermines a fundamental societal need for the receipt of safe care. Current interventions for improving health care quality and safety have mainly focused on identifying and monitoring vulnerable patients (eg, patients with complex health care needs) and occasionally vulnerable systems.<sup>73,74</sup> Our findings support the view that existing care quality and patient safety standards are incomplete; a core but neglected contributor is physician wellness.<sup>1-4</sup> This recommendation is in accordance with all well-recognized patient safety classification systems (eg, World Health Organization), which concur that there are 3 major contributory factors to patient safety incidents: patient, health care system, and clinician factors.

High depersonalization in physicians was particularly indicative that patient care could be at risk, as it had associations with both increased patient safety incidents and reduced professionalism. Depersonalization was also associated with lower patient satisfaction, suggesting that its results can be perceived by patients. These findings are consistent with existing evidence showing that depersonalization is related to low professionalism.<sup>75,76</sup> Depersonalization scores in physicians could be measured by health care organizations together with other well-established quality strategies to guide system-level interventions for improving quality of health care and patient safety.

Most of the studies relied on patient care outcomes that were self-reported by physicians. However, we failed to show significant links between physician burnout and patient safety outcomes recorded in the health care systems (eg, the health records of patients, surveillance). Concerns have frequently been raised about poor and inconsistent system recording of patient safety outcomes.<sup>77</sup> As such, our findings suggest that existing system-based assessment methods are incomplete and less sensitive to the full range of patient safety outcomes reported by physicians and patients. These uncaptured safety outcomes might include “near misses,” but may also concern incidents different in nature, such as psychological harm, that do not result in directly observable patient harm but may affect the physician-patient relationship and indirectly harm both parties.

# This article has been retracted

Reporting systems for quality of care and patient safety outcomes require revision and better standardization across health care organizations. This standardization will enable larger and more rigorous studies of the association between physician burnout and key aspects of patient care that will be accessible at an organizational level and affect policy decisions. An alternative explanation for this finding is that physicians' perceptions of safety are unreliable; however, this conclusion is not supported by previous research suggesting that staff-reported patient safety outcomes overlap with objective safety indicators.<sup>78,79</sup> That said, association between burnout and self-criticism on physicians' reports and patient safety outcomes warrants further investigation.

Another finding is that studies based on resident and early-career physicians reported stronger links between burnout and low professionalism compared with studies based on middle- and late-career physicians. It is likely that burnout signs among residents and early-career physicians have detrimental associations with their work satisfaction, professional values, and integrity.<sup>80-82</sup> Health care organizations have a duty to support physicians in the demanding transition from training to professional life. Residents will be responsible for the health care delivery for over 2 decades in the future. Investments in their wellness and professional values, which are largely shaped during early-career years, are perhaps the most efficient strategy for building organizational immunity against workforce shortages and patient harm/mistrust.

## Strengths and Limitations

This study has both strengths and limitations. We undertook a rigorous quantitative assessment of the association between burnout and patient care quality and safety in a pooled sample of more than 42 000 physicians. Meta-analysis allowed us to compare the results across individual studies, examine the consistency of associations, and explore variables that might account for inconsistency.

However, there are also limitations. A wide range of outcomes was included in this review, and some outcomes pooled

together in the same subcategory exhibited substantial variation (eg, professionalism). Similarly, although we focused on physicians, this is a broad research population of health professionals working in various health care settings and specialties. We accounted for the large heterogeneity by applying random-effects models to adjust for study-level variations and by undertaking subgroup analyses to explore key factors that may account for variation. We only explored the outcome of basic sources of heterogeneity because multiple subgroup analyses inflate the probability of finding false results.<sup>83</sup> We excluded gray literature because the quality of research contained in the gray literature is generally lower and more difficult to combine with research contained in peer-reviewed journal articles.<sup>84</sup> The visual inspection of the funnel plot and Egger test did not identify evidence of publication bias in any of our analyses, which supports our decision. However, we cannot fully eliminate the possibility that the exclusion of gray literature has introduced undetected selection bias. Finally, the design of the original studies (mostly cross-sectional) imposes limits on our ability to establish causal links between physician burnout and patient safety, professionalism, and patient satisfaction and the mechanisms that underpin these links.

## Conclusions

The primary conclusion of this review is that physician burnout might jeopardize patient care. Physician wellness and quality of patient care are critical and complementary dimensions of health care organization efficiency. Investments in organizational strategies to jointly monitor and improve physician wellness and patient care outcomes are needed. Interventions aimed at improving the culture of health care organizations as well as interventions focused on individual physicians but supported and funded by health care organizations are beneficial.<sup>2,85,86</sup> They should therefore be evaluated at scale and implemented.

## ARTICLE INFORMATION

**Accepted for Publication:** June 15, 2018.

**Published Online:** September 4, 2018.  
doi:10.1001/jamainternmed.2018.3713

**Retraction:** This article was retracted on May 18, 2020.

**Correction:** This article was corrected online March 4, 2019, to correct data-entry errors in the Table, typographical errors in Figure 2, and a reversed description in Figure 4 for favors low and favors high patient satisfaction.

**Author Affiliations:** National Institute for Health Research (NIHR) School for Primary Care Research, NIHR Greater Manchester Patient Safety Translational Research Centre, Manchester Academic Health Science Centre, University of Manchester, Manchester, United Kingdom (Panagioti); NIHR School for Primary Care Research, Manchester Academic Health Science Centre, University of Manchester, Manchester, United Kingdom (Geraghty, Zhou, Hodkinson, Esmail); Bradford Institute for Health Research, University

of Leeds, Leeds, United Kingdom (Johnson); Laboratory of Hygiene, Aristotle Medical School, Aristotle University of Thessaloniki, Thessaloniki, Greece (Panagopoulou); Research Institute, Primary Care and Health Sciences, Keele University, Keele, Newcastle, United Kingdom (Chew-Graham); Westminster Centre for Resilience, Faculty of Science and Technology, University of Westminster, London, United Kingdom (Peters); Institute of Applied Health Research College of Medical and Dental Sciences, Murray Learning Centre, University of Birmingham, Edgbaston, Birmingham, United Kingdom (Riley).

**Author Contributions:** Dr Panagioti had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

**Concept and design:** Panagioti, Geraghty, Panagopoulou, Chew-Graham, Peters, Riley, Esmail.  
**Acquisition, analysis, or interpretation of data:** Panagioti, Geraghty, Johnson, Zhou, Hodkinson.  
**Drafting of the manuscript:** Panagioti, Hodkinson.  
**Critical revision of the manuscript for important**

**intellectual content:** Panagioti, Geraghty, Johnson, Zhou, Panagopoulou, Chew-Graham, Peters, Hodkinson, Riley, Esmail.

**Statistical analysis:** Panagioti, Hodkinson.

**Obtained funding:** Panagioti.

**Administrative, technical, or material support:** Geraghty, Johnson, Zhou.

**Supervision:** Panagioti, Panagopoulou.

**Conflict of Interest Disclosures:** None reported.

**Funding/Support:** This study was funded by the United Kingdom National Institute of Health Research (NIHR) School for Primary Care Research (project 298) and the NIHR Greater Manchester Patient Safety Translational Research Centre funded Dr Panagioti's time contributed to this project. The research team members were independent from the funding agencies.

**Role of the Funder/Sponsor:** The funding organizations had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

# This article has been retracted

**Disclaimer:** The views expressed in this publication are those of the authors and not necessarily those of the National Health Service, the NIHR, or the Department of Health.

## REFERENCES

- Wallace JE, Lemaire JB, Ghali WA. Physician wellness: a missing quality indicator. *Lancet*. 2009; 374(9702):1714-1721. doi:10.1016/S0140-6736(09)61424-0
- Firth-Cozens J. Interventions to improve physicians' well-being and patient care. *Soc Sci Med*. 2001;52(2):215-222. doi:10.1016/S0277-9536(00)00221-5
- Firth-Cozens J, Greenhalgh J. Doctors' perceptions of the links between stress and lowered clinical care. *Soc Sci Med*. 1997;44(7):1017-1022.
- Shanafelt TD, Bradley KA, Wipf JE, Back AL. Burnout and self-reported patient care in an internal medicine residency program. *Ann Intern Med*. 2002;136(5):358-367. doi:10.7326/0003-4819-136-5-200203050-00008
- Maslach C, Schaufeli WB, Leiter MP. Job burnout. *Annu Rev Psychol*. 2001;52:397-422. doi:10.1146/jannurevpsych.52.1.397
- 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 Clin Proc*. 2015;90(12):1600-1613. doi:10.1016/j.mayocp.2015.08.023
- Peckham C. Medscape Lifestyle Report 2017: race and ethnicity, bias and burnout. <https://www.medscape.com/features/slideshow/lifestyle/2017/overview>. Updated July 30, 2018. Accessed July 25, 2018.
- Shanafelt TD, Balch CM, Bechamps G, et al. Burnout and medical errors among American surgeons. *Ann Surg*. 2010;251(6):995-1000. doi:10.1097/SLA.0b013e3181bfdbd3
- Shanafelt TD, Gradishar WJ, Kosty M, et al. Burnout and career satisfaction among US oncologists. *J Clin Oncol*. 2014;32(7):678-686. doi:10.1200/JCO.2013.51.8480
- Anagnostopoulos F, Liolios E, Persefonis G, Slater J, Kafetsios K, Niakas D. Physician burnout and patient satisfaction with consultation in primary health care settings: evidence of relationships from a one-with-many design. *J Clin Psychol Med Settings*. 2012;19(4):401-410. doi:10.1007/s10880-011-9278-8
- Dewa CS, Loong D, Bonato S, Trojanowski L. The relationship between physician burnout and quality of healthcare in terms of safety and acceptability: a systematic review. *BMJ Open*. 2017;7(6):e015141. doi:10.1136/bmjopen-2016-015141
- Hall LH, Johnson J, Watt I, Tsipa A, O'Connor DB. Healthcare staff wellbeing, burnout, and patient safety: a systematic review. *PLoS One*. 2016; 11(7):e0159015. doi:10.1371/journal.pone.0159015
- Stroup DF, Berlin JA, Morton SC, et al; Meta-analysis of Observational Studies in Epidemiology (MOOSE) Group. Meta-analysis of observational studies in epidemiology: a proposal for reporting. *JAMA*. 2000;283(15):2008-2012. doi:10.1001/jama.283.15.2008
- Moher D, Liberati A, Tetzlaff J, Altman DG; PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Med*. 2009;6(7):e1000097. doi:10.1371/journal.pmed.1000097
- Maslach C, Jackson S, Leiter M. *Maslach Burnout Inventory Manual*. Palo Alto, CA: Consulting Psychologists Press; 1996.
- Bianchi R, Schonfeld IS, Laurent E. Burnout-depression overlap: a review. *Clin Psychol Rev*. 2015;36:28-41. doi:10.1016/j.cpr.2015.01.004
- Vincent C. *Patient Safety*. Edinburgh, UK: Churchill Livingstone; 2005.
- Kanter MH, Nguyen M, Klau MH, Spiegel NH, Ambrosini VL. What does professionalism mean to the physician? *Perm J*. 2013;17(3):87-90. doi:10.7812/TPP12-120
- Panagioti M, Stokes J, Esmail A, et al. Multimorbidity and patient safety incidents in primary care: a systematic review and meta-analysis. *PLoS One*. 2015;10(8):e0135947. doi:10.1371/journal.pone.0135947
- Thomas BH, Ciliska D, Dobbins M, Micucci S. A process for systematically reviewing the literature: providing the research evidence for public health nursing interventions—worldviews on evidence-based nursing: Sigma Theta Tau International. *Honor Soc Nurs*. 2004;1(3):176-184.
- Higgins JPT, Green S, eds. *Cochrane Handbook for Systematic Reviews of Interventions*, Version 5.1.0 The Cochrane Collaboration, 2011. [www.handbook.cochrane.org](http://www.handbook.cochrane.org). Updated March 2011. Accessed July 25, 2018.
- Dollarhide AW, Rutledge T, Weinger MB, et al. A real-time assessment of factors influencing medication events. *J Healthc Qual*. 2014;36(5):5-12. doi:10.1111/jhq.12012
- Eckleberry-Hunt J, Kirkpatrick H, Taku K, Hunt R. Self-report study of predictors of physician wellness, burnout, and quality of patient care. *South Med J*. 2017;110(4):244-248. doi:10.14423/SMJ.0000000000000629
- Higgins JP, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. *BMJ*. 2003;327(7414):557-560. doi:10.1136/bmj.327.7414.557
- 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. doi:10.1136/bmj.315.7109.629
- Kontopantelis E, Reeves D. Meta-analysis: random-effects meta-analysis. *Stata J*. 2010;10(3):395-407.
- Sterne JAC, Harbord RM. Funnel plots in meta-analysis. *Stata J*. 2004;4(2):127-141.
- Harbord RM, Harris RJ, Sterne JAC. Updated tests for small-study effects in meta-analyses. *Stata J*. 2009;9(2):197-210.
- Asai M, Morita T, Akechi T, et al. Burnout and psychiatric morbidity among physicians engaged in end-of-life care for cancer patients: a cross-sectional nationwide survey in Japan. *Psychooncology*. 2007;16(5):421-428. doi:10.1002/pon.1066
- Baer TE, Feraco AM, Tuysuzoglu Sagalowsky S, Williams D, Litman HJ, Vinci RJ. Pediatric resident burnout and attitudes toward patients. *Pediatrics*. 2017;139(3):1-8. doi:10.1542/peds.2016-2163
- Balch CM, Oreskovich MR, Dyrbye LN, et al. Personal consequences of malpractice lawsuits on American surgeons. *J Am Coll Surg*. 2011;213(5):657-667. doi:10.1016/j.jamcollsurg.2011.08.005
- Bourne T, Wynants L, Peters M, et al. The impact of complaints procedures on the welfare, health and clinical practise of 7926 doctors in the UK: a cross-sectional survey. *BMJ Open*. 2015;5(1):e006687. doi:10.1136/bmjopen-2014-006687
- Brazeau CMLR, Schroeder R, Rovi S, Boyd L. Relationships between medical student burnout, empathy, and professionalism climate. *Acad Med*. 2010;85(10)(suppl):S33-S36. doi:10.1097/ACM.0b013e3181ed4c47
- Brown R, Dunn S, Byrnes K, Morris R, Heinrich P, Shaw J. Doctors' stress responses and poor communication performance in simulated bad-news consultations. *Acad Med*. 2009;84(11):1595-1602. doi:10.1097/ACM.0b013e3181bfaf537
- Chen K-Y, Yang C-M, Lien C-H, et al. Burnout, job satisfaction, and medical malpractice among physicians. *Int J Med Sci*. 2013;10(11):1471-1478. doi:10.7150/ijms.6743
- Cooke GPE, Doust JA, Steele MC. A survey of resilience, burnout, and tolerance of uncertainty in Australian general practice registrars. *BMC Med Educ*. 2013;13:2. doi:10.1186/1472-6920-13-2
- de Oliveira GS Jr, Chang R, Fitzgerald PC, et al. The prevalence of burnout and depression and their association with adherence to safety and practice standards: a survey of United States anesthesiology trainees. *Anesth Analg*. 2013;117(1):182-193. doi:10.1213/ANE.0b013e3182917da9
- Fahrenkopf AM, Sctish TC, Barger LK, et al. Rates of medication errors among depressed and burnt out residents: prospective cohort study. *BMJ*. 2008;336(7642):488-491. doi:10.1136/bmj.39469.763218.BE
- Garrouste-Orgeas M, Perrin M, Soufir L, et al. The latroref study: medical errors are associated with symptoms of depression in ICU staff but not burnout or safety culture. *Intensive Care Med*. 2015; 41(2):273-284. doi:10.1007/s00134-014-3601-4
- Halbesleben JRB, Rathert C. Linking physician burnout and patient outcomes: exploring the dyadic relationship between physicians and patients. *Health Care Manage Rev*. 2008;33(1):29-39. doi:10.1097/O1.HMR.0000304493.87898.72
- Hansen RP, Vedsted P, Sokolowski I, Søndergaard J, Olesen F. General practitioner characteristics and delay in cancer diagnosis: a population-based cohort study. *BMC Fam Pract*. 2011;12:100. doi:10.1186/1471-2296-12-100
- Hayashino Y, Utsugi-Ozaki M, Feldman MD, Fukuhara S. Hope modified the association between distress and incidence of self-perceived medical errors among practicing physicians: prospective cohort study. *PLoS One*. 2012;7(4):e35585. doi:10.1371/journal.pone.0035585
- Kalmbach DA, Arnedt JT, Song PX, Guille C, Sen S. Sleep disturbance and short sleep as risk factors for depression and perceived medical errors in first-year residents. *Sleep*. 2017;40(3):1-8. doi:10.1093/sleep/zsw073
- Kang EK, Lihm HS, Kong EH. Association of intern and resident burnout with self-reported medical errors. *Korean J Fam Med*. 2013;34(1):36-42. doi:10.4082/kjfm.2013.34.1.36
- Klein J, Grosse Frie K, Blum K, von dem Knesebeck O. Burnout and perceived quality of care among German clinicians in surgery. *Int J Qual*



# This article has been retracted

*Health Care.* 2010;22(6):525-530. doi:10.1093/intqhc/mzq056

46. Krebs EE, Garrett JM, Konrad TR. The difficult doctor? characteristics of physicians who report frustration with patients: an analysis of survey data. *BMC Health Serv Res.* 2006;6:128. doi:10.1186/1472-6963-6-128

47. Kwah J, Weintraub J, Fallar R, Ripp J. The effect of burnout on medical errors and professionalism in first-year internal medicine residents. *J Grad Med Educ.* 2016;8(4):597-600. doi:10.4300/JGME-D-15-00457.1

48. Lafreniere JP, Rios R, Packer H, Ghazarian S, Wright SM, Levine RB. Burned out at the bedside: patient perceptions of physician burnout in an internal medicine resident continuity clinic. *J Gen Intern Med.* 2016;31(2):203-208. doi:10.1007/s11606-015-3503-3

49. Linzer M, Manwell LB, Williams ES, et al; MEMO (Minimizing Error, Maximizing Outcome) Investigators. Working conditions in primary care: physician reactions and care quality. *Ann Intern Med.* 2009;151(1):28-36, W6-9.

50. Lu DW, Dresden S, McCloskey C, Branzetti J, Gisoni MA. Impact of burnout on self-reported patient care among emergency physicians. *West J Emerg Med.* 2015;16(7):996-1001. doi:10.5811/westjem.2015.9.27945

51. O'Connor P, Lydon S, O'Dea A, et al. A longitudinal and multicentre study of burnout and error in Irish junior doctors. *Postgrad Med J.* 2017; 93(1105):660-664. doi:10.1136/postgradmedj-2016-134626

52. Ožvačić Adžić Z, Katić M, Kern J, Soler JK, Cerovečki V, Polašek O. Is burnout in family physicians in Croatia related to interpersonal quality of care? *Arh Hig Rada Toksikol.* 2013;64(2):69-78. doi:10.2478/10004-1254-64-2013-2307

53. Park C, Lee YJ, Hong M, et al. A multicenter study investigating empathy and burnout characteristics in medical residents with various specialties. *J Korean Med Sci.* 2016;31(4):590-597. doi:10.3346/jkms.2016.31.4.590

54. Passalacqua SA, Segrin C. The effect of resident physician stress, burnout, and empathy on patient-centered communication during the long-call shift. *Health Commun.* 2012;27(5):449-456. doi:10.1080/10410236.2011.606527

55. Pedersen AF, Carlsen AH, Vedsted P. Association of GPs' risk attitudes, level of empathy, and burnout status with PSA testing in primary care. *Br J Gen Pract.* 2015;65(641):e845-e851. doi:10.3399/bjgp15X687649

56. Prins JT, van der Heijden FMMA, Hoekstra-Weebers JEHM, et al. Burnout, engagement and resident physicians' self-reported errors. *Psychol Health Med.* 2009;14(6):654-666. doi:10.1080/13548500903311554

57. Qureshi HA, Rawlani R, Mioton LM, Dumanian GA, Kim JYS, Rawlani V. Burnout phenomenon in US plastic surgeons: risk factors and impact on quality of life. *Plast Reconstr Surg.* 2015;135(2):619-626. doi:10.1097/PRS.0000000000000855

58. 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. doi:10.1007/s11606-008-0702-1

59. Shanafelt TD, West C, Zhao X, et al. Relationship between increased personal well-being and enhanced empathy among internal medicine residents. *J Gen Intern Med.* 2005;20(7):559-564. doi:10.1007/s11606-005-0102-8

60. Toral-Villanueva R, Aguilar-Madrid G, Juárez-Pérez CA. Burnout and patient care in junior doctors in Mexico City. *Occup Med (Lond).* 2009; 59(1):8-13. doi:10.1093/occmed/kqn122

61. Yuguero Torres O, Esquerda Aresté M, Marsal Mora JR, Soler-González J. Association between sick leave prescribing practices and physician burnout and empathy. *PLoS One.* 2015;10(7):1-9. doi:10.1371/journal.pone.0133379

62. Travado L, Grassi L, Gil F, Ventura C, Martins C; Southern European Psycho-Oncology Study Group. Physician-patient communication among Southern European cancer physicians: the influence of psychooncology orientation and burnout. *Psychooncology.* 2005;14(8):661-670. doi:10.1002/pon.890

63. van den Hombergh P, Künzi B, Elwyn G, et al. High workload and job stress are associated with lower practice performance in general practice: an observational study in 239 general practices in the Netherlands. *BMC Health Serv Res.* 2009;9:118. doi:10.1186/1472-6963-9-118

64. Walocha E, Tomaszewski KA, Wilczek-Ruzyczka E, Walocha J. Empathy and burnout among physicians of different specialties. *Folia Med Cracov.* 2013;53(2):35-42.

65. Weigl M, Schneider A, Hoffmann F, Angerer P. Work stress, burnout, and perceived quality of care: a cross-sectional study among hospital pediatricians. *Eur J Pediatr.* 2015;174(9):1237-1246. doi:10.1007/s00431-015-2529-1

66. Welp A, Meier LL, Manser T. Emotional exhaustion and workload predict clinician-rated and objective patient safety. *Front Psychol.* 2015;5:1573. doi:10.3389/fpsyg.2014.01573

67. Wen J, Cheng Y, Hu X, Yuan P, Hao T, Shi Y. Workload, burnout, and medical mistakes among physicians in China: a cross-sectional study. *Biosci Trends.* 2016;10(1):27-33. doi:10.5582/bst.2015.01175

68. Weng H-C, Hung C-M, Liu Y-T, et al. Associations between emotional intelligence and doctor burnout, job satisfaction and patient satisfaction. *Med Educ.* 2011;45(8):835-842. doi:10.1111/j.1365-2923.2011.03985.x

69. 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. doi:10.1001/jama.296.9.1071

70. 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. doi:10.1001/jama.2009.1389

71. 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. doi:10.1001/archinternmed.2012.3199

72. Bates DW, Spell N, Cullen DJ, et al; Adverse Drug Events Prevention Study Group. The costs of adverse drug events in hospitalized patients. *JAMA.* 1997;277(4):307-311. doi:10.1001/jama.1997.03540280045032

73. Avery AJ, Rodgers S, Cantrill JA, et al. A pharmacist-led information technology intervention for medication errors (PINCER): a multicentre, cluster randomised, controlled trial and cost-effectiveness analysis. *Lancet.* 2012;379(9823):1310-1319. doi:10.1016/S0140-6736(11)61817-5

74. Khalil H, Bell B, Chambers H, Sheikh A, Avery AJ. Professional, structural and organisational interventions in primary care for reducing medication errors. *Cochrane Database Syst Rev.* 2017;10:CD003942.

75. Dyrbye LN, West CP, Shanafelt TD. Defining burnout as a dichotomous variable. *J Gen Intern Med.* 2009;24(3):440. doi:10.1007/s11606-008-0876-6

76. 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. doi:10.1001/jamainternmed.2013.14387

77. Sari AB, Sheldon TA, Cracknell A, Turnbull A. Sensitivity of routine system for reporting patient safety incidents in an NHS hospital: retrospective patient case note review. *BMJ.* 2007;334(7584):79. doi:10.1136/bmj.39031.507153.AE

78. Mardon RE, Khanna K, Sorra J, Dyer N, Famolaro T. Exploring relationships between hospital patient safety culture and adverse events. *J Patient Saf.* 2010;6(4):226-232. doi:10.1097/PTS.0b013e3181fd1a00

79. Hansen LO, Williams MV, Singer SJ. Perceptions of hospital safety climate and incidence of readmission. *Health Serv Res.* 2011;46(2):596-616. doi:10.1111/j.1475-6773.2010.01204.x

80. Thomas NK. Resident burnout. *JAMA.* 2004;292(23):2880-2889. doi:10.1001/jama.292.23.2880

81. Dyrbye L, Shanafelt T. A narrative review on burnout experienced by medical students and residents. *Med Educ.* 2016;50(1):132-149. doi:10.1111/medu.12927

82. 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. doi:10.1016/j.mayocp.2013.07.016

83. 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. doi:10.1371/journal.pone.0069930

84. McAuley L, Pham B, Tugwell P, Moher D. Does the inclusion of grey literature influence estimates of intervention effectiveness reported in meta-analyses? *Lancet.* 2000;356(9237):1228-1231. doi:10.1016/S0140-6736(00)02786-0

85. West CP, Dyrbye LN, Erwin PJ, Shanafelt TD. Interventions to prevent and reduce physician burnout: a systematic review and meta-analysis. *Lancet.* 2016;388(10057):2272-2281. doi:10.1016/S0140-6736(16)31279-X

86. Panagioti M, Panagopoulou E, Bower P, et al. Controlled interventions to reduce burnout in physicians: a systematic review and meta-analysis. *JAMA Intern Med.* 2017;177(2):195-205. doi:10.1001/jamainternmed.2016.7674