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A Systematic Review of the Relationship between Physician Burnout and Safety-related and Acceptability-related Quality of Healthcare

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Abstract

Objectives. This study reviews the current state of the published peer-reviewed literature related to physician burnout and two quality of care dimensions. The purpose of this systematic literature review is to address the question, "How does physician burnout affect the quality of healthcare related to the dimensions of acceptability and safety?"

Design. Using a multi-phase screening process, this systematic literature review was based on publically available peer-reviewed studies. Five electronic databases were searched: (1) Medline Current, (2) Medline In-process, (3) PsycINFO, (4) Embase and (5) Web of Science.

Setting. The focus is on physicians practicing in civilian settings.

Participants. Physicians who are in practice and have completed training.

Primary and secondary outcome measures. Quality of healthcare related to acceptability (i.e., patient satisfaction, physician communication, physician attitudes) and safety (i.e., minimizing risks or harm to patients)

Results. 3255 unique citations were identified. Of these, 10 articles were included in the review. One of the 10 studies was rated as having low risk of bias and 9 as having moderate risk. Three studies were conducted in North America; four in Europe, one in the Middle East, and two in East Asia. Results of this systematic literature review suggest there is moderate evidence that burnout is associated with safety-related quality of care. Because of the variability in the way patient acceptability-related quality of care was measured and the inconsistency in study findings, the evidence supporting the relationship between burnout and patient acceptability-related quality of care is less strong.

Conclusions. The focus on direct care-related quality highlights additional ways that physician burnout affects the healthcare system. These studies can help to inform decisions about how to improve patient care by addressing physician burnout. Continued work looking at the relationship between dimensions of acceptability-related quality of measures and burnout is needed to advance the field.

ARTICLE SUMMARY

STRENGTHS AND LIMITATIONS OF THIS STUDY:

- Few studies have examined the current state of knowledge about the relationship between physician burnout and the patient safety and acceptability dimensions of quality of care.
- This systematic literature review employed a broad search of five electronic databases: (1) Medline Current, (2) Medline In-process, (3) PsycINFO, (4) Embase and (5) Web of Science. A manual search was also conducted. In total, 3255 unique citations were identified and reviewed by two reviewers.
- The results of the search identified 10 papers that met inclusion criteria; they reported on studies conducted in a variety of countries suggesting that the question of the impact of physician burnout on quality of care is of interest in health systems globally.
- There was variability among the identified studies with respect to outcome measures and reporting of population characteristics.
- The results of this body of literature could be strengthened by the use of longitudinal study designs.

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Reports from around the world indicate that about one-third to one-half of physicians experience at least one dimension of burnout.[1-5] Burnout has been conceptualized as a syndrome consisting of three dimensions: emotional exhaustion (EE), depersonalization (DP) and low personal accomplishment (PA).[6] Maslach et al.[7] defines EE as referring to "feelings of being overextended and depleted of one's emotional and physical resources." DP is also referred to as cynicism and they define it as "a negative, callous, or excessively detached response to various aspects".[7] PA is also referred to as professional efficacy and "it refers to feelings of incompetence and a lack of achievement and productivity at work".[7] Burnout has been observed to affect personal well-being through low job satisfaction[8-10] and decreased mental health.[11]

Because physicians play an integral role in the healthcare system, the effects of physician burnout are not limited to the physicians experiencing it. Rather, physician burnout potentially impacts the entire healthcare system. For example, a recent systematic literature review reported a negative relationship between burnout and productivity (i.e., early retirement, work cutback, and quitting).[12] The impact of productivity loss related to burnout could lead to fewer available healthcare resources that in turn, can result in healthcare service waitlists. One estimate of the costs of physician work cutback and early retirement related to burnout suggests it totals to at least CAD $213 million in patient services losses.[8]

This raises another question about physicians who continue to practice despite experiencing burnout. Does burnout affect their practice? There is evidence that physician burnout is also related to decreased quality of patient care.[5] The World Health Organization (WHO)[13] and the Institute of Medicine (IOM)[14] suggest that there are six dimensions for quality of healthcare care: effectiveness, efficiency, accessibility, equitability, acceptability, and safety.

The purpose of this systematic literature review is to address the question, "How does physician burnout affect the quality of healthcare related to the dimensions of acceptability and safety?" In this review, we focus on the two dimensions of quality – acceptability (i.e., patient satisfaction, perceived quality of care, and communication) and safety (i.e., minimizing risks or harm to patients). We choose these two dimensions because they reflect the quality of patient-physician interactions.[15] That is, if a clinician's wellbeing is compromised, their patient interactions may also be negatively affected.[16] In contrast, effectiveness, efficiency, accessibility, equitability reflect the systems (i.e., infrastructure, information technology, payment policies) in which practice is conducted.[14]

Background

There has been growing interest in the relationship between physician wellbeing and quality of patient care. Although the WHO[13] and IOM[14] identify six dimensions of quality of healthcare care, attention has focused on the dimension of patient safety. Recently, there have been three published reviews examining the relationship between clinician and physician wellbeing and patient safety.[17-19] However, each of these published reviews answered questions that were different from the one addressed in our review. Because they sought to answer different questions, they employed different search strategies and inclusion/exclusion criteria from ours. Consequently, they included different articles from ours. For example, Hall et al.'s[18] review does not include seven articles that are in included in our systematic review. Among these, there are six articles related to acceptability and one article related to patient safety that were not included in Hall et al.'s[18] review. Furthermore, there are only four papers that overlap; one is on acceptability and three on patient safety. In comparison to de Jong et al.'s review,[17] our review has nine articles that are unique to our systematic review; six are related to

acceptability and three to patient safety. None of the articles included in our review were included in Williams and Skinner's.[19] Thus, our review includes papers that have not been considered together to look at quality of care related to physician interactions with patients and the impact of burnout on physicians.

In addition, none of the published reviews considers the quality of care dimension of acceptability for physicians who have completed training. Yet, along with patient safety, this dimension reflects the quality of interactions between providers and patients. The physician-patient interactions are one of the fundamental interactions in healthcare.[15,19] Furthermore, the IOM[14] asserts that the rise in chronic illnesses necessitates quality interactions to enhance the collaboration between the physician and patient. Quality of physician-patient interactions are reflected in communication, perceived quality of care, and patient satisfaction.[14,15] It is the physician-patient interaction that supports the collaboration that will lead to better patient outcomes.[15]

Wallace et al.[16] assert that physician wellbeing could be used as a quality indicator. The argument could be strengthened by also understanding how wellbeing is associated with the physician-patient interaction-related quality dimensions of safety and acceptability. In particular, burnout could be a focus because it reflects wellbeing and there are standardized measures to identify it. Furthermore, it is a facet of wellbeing that can be influenced by organizational factors and is under the influence of the healthcare system.[16,20,21] Thus, this systematic review of the literature extends our knowledge about the dimensions of quality of care that reflect physician interactions with patients and a dimension of wellbeing that is affected by the work environment.

METHODS

A systematic review of the literature was reported following the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA) guidelines.[22] Ethics board review was not sought because this review relied solely on publicly available sources of information.

Information Sources

Five databases were searched: (1) *Medline Current* (index of biomedical research and clinical sciences journal articles); (2) *Medline In-Process* (index of biomedical research and clinical sciences journal articles awaiting to be indexed into *Medline Current*); (3) *PsycINFO* (an index of journal articles, books, chapters, and dissertations in psychology, social sciences, behavioral sciences, and health sciences); (4) *Embase* (index of biomedical research, and abstracts from biomedical, drug and medical device conferences); and (5) *Web of Science* (index of journal articles, editorially selected books and conference proceedings in life sciences and biomedical research).

Search Strategy

Collaborating with the professional health science librarian (SB) member of this research team, search strategies were developed and tailored for each database following the Peer Review of Electronic Search Strategies (PRESS) guidelines[23] (Table 1). The searches were conducted between August – October 2015. The OVID platform was used to search *Medline Current*, *Medline In-Process*, *PsycINFO*, and *Embase*. *Web of Science* was searched using the Thomson Reuters search interface. The search period covered January 2002 – September 2015; all searches were limited to English language journals. The time frame was chosen to represent the current healthcare environments in which physicians are practicing. Searches sought to identify articles about practicing physicians regardless of specialty working in civilian settings (i.e., non-

military settings). In this review, the physician search included: allergists, anesthesiologists, cardiologists, clinical pharmacologists, clinical toxicologists, dermatologists, doctors, endocrinologists, gastroenterologists, gynecologists, hematologists, immunologists, medical biochemists, medical geneticists, medical microbiologists, nephrologists, neurologists, neuropathologists, neuroradiologists, occupational physicians, oncologists, ophthalmologists, pathologists, pediatricians, physicians, psychiatrists, radiologists, rheumatologists, surgeons, and urologists. The search strategy did not seek to exclude residents and medical students. Rather, a broad search strategy was employed to increase the likelihood that all studies on physician burnout would be found. The reference lists of all accepted full-text articles were hand searched.

Table 1. Search terms used in search strategy

Database	Search Terms
Medline Current	[exp Burnout, Professional/ OR burnout.mp. OR (burnout adj3 effect$).mp.] **AND** [exp Physicians/ OR exp Psychiatry/ OR allergist$.mp. OR anesthesiologist$.mp. OR cardiologist$.mp. OR clinical pharmacologist$.mp. OR clinical toxicologist$.mp. OR dermatologist$.mp. OR doctor$.mp. OR endocrinologist$.mp. OR gastroenterologist$.mp. OR gynecologist$.mp. OR hematologist$.mp. OR immunologist$.mp. OR medical biochemist$.mp. OR medical geneticist$.mp. OR medical microbiologist$.mp. OR nephrologist$.mp. OR neurologist$.mp. OR neuropathologist$.mp. OR neuroradiologist$.mp. OR occupational physician$.mp. OR oncologist$.mp. OR ophthalmologist$.mp. OR pathologist$.mp. OR pediatrician$.mp. OR physician$.mp. OR psychiatrist$.mp. OR radiologist$.mp. OR rheumatologist$.mp. OR surgeon$.mp. OR urologist$.mp.] **AND** [exp Diagnostic Errors/ OR exp Medical Errors/ OR exp Medication Errors/ OR exp "Quality of Health Care"/ OR exp Quality Assurance, Health Care/ OR misdiag$.mp. OR (diagnos$ adj3 error$).mp. OR (medical$ adj3 error$).mp. OR (medication$ adj3 error$).mp. OR (drug$ adj3 error$).mp. OR (mistak$ adj3 medic$).mp. OR (surgic$ adj3 error$).mp. OR (quality$ adj3 health$ adj3 care$).mp. OR (quality$ adj3 healthcare$).mp. OR (quality$ adj3 of adj3 care$).mp. OR exp Professional Competence/ OR (professional$ adj3 competenc$).mp. OR (technical$ adj3 expertise$).mp. OR (expertise$ adj3 generaliz$).mp. OR professionalism$.mp. OR exp Treatment Outcome/ OR (treat$ adj3 outcome$).mp. OR (patient$ adj3 outcome$).mp. OR exp Professional Impairment/ OR (impair$ adj3 physician$).mp. OR (impair$ adj3 doctor$).mp. OR (disruptive$ adj3 behav$).mp. OR exp Safety/ OR safe$.mp. OR exp Risk/ OR risk$.mp. OR exp Patient Satisfaction/ OR (patient$ adj3 satisf$).mp. OR (client$ adj3 satisf$).mp. OR exp Professional-Patient Relations/ OR (professional$ adj3 patient$ adj3 relation$).mp. OR (client$ adj3 contact$).mp. OR exp Physician-Patient Relations/ OR (physician$ adj3 patient$ adj3 relation$).mp. OR (doctor$ adj3 patient$ adj3 relation$).mp. OR exp Communication/ OR communicat$.mp. OR misinform$.mp. OR exp Health Communication/ OR exp "Attitude of Health Personnel"/ OR attitude$.mp. OR exp Clinical Competence/ OR (clinical$ adj3 competenc$).mp. OR (clinical$ adj3 skill$).mp. OR exp Patient-Centered Care/ OR (patient$ adj3 cent$ adj3 care$).mp. OR (patient$ adj3 focus$ adj3 care$).mp. OR exp Empathy/ OR empath$.mp. OR exp Patient Care/ OR (patient$ adj3 care$).mp. OR (informal$ adj3 care$).mp. OR exp "Standard of Care"/ OR (standard$ adj3 care$).mp. OR st.fs. [standards - floating subheading] OR exp Self Efficacy/ OR efficacy$.mp. OR exp Clinical Audit/ OR audit$.mp. OR exp Medical Audit/ OR (diagnos$ adj3 mistak$).mp. OR (medication$ adj3 mistak$).mp. OR (drug$ adj3 mistak$).mp. OR (surgic$ adj3 mistak$).mp. OR exp Safety Management/ OR (program$ adj3 hazard$ adj3 surveillance$).mp. OR (management$ adj3 safety$).mp. OR (hazard$ adj3 control$).mp. OR (hazard$ adj3 management$).mp. OR exp Malpractice/ OR malpractic$.mp. OR negligen$.mp. OR exp Morbidity/ OR morbidit$.mp. OR exp Postoperative Complications/ OR (postoperative$ adj3 complication$).mp. OR exp Cross Infection/ OR (nosocomial$ adj3 infection$).mp. OR (hospital$ adj3 infection$).mp. OR (cross$ adj3 infection$).mp. OR exp Physician's Practice Patterns/ OR (practice$ adj3 pattern$ adj3 clinical$).mp. OR (practice$ adj3 pattern$ adj3 physician$).mp. OR (prescribing$ adj3 pattern$ adj3 physician$).mp. OR (practice$ adj3 pattern$ adj3 professional$).mp. OR (practice$ adj3 pattern$ adj3 variation$).mp. OR (practice$ adj3 clinical$ adj3 variation$).mp. OR (practice$ adj3 medical$ adj3 variation$).mp. OR exp Mortality/ OR (rate$ adj3 age-specific$ adj3 death$).mp. OR (rate$ adj3 death$).mp. OR (rate$ adj3 fatalit$).mp. OR mortalit$.mp. OR exp "Outcome Assessment (Health Care)"/ OR (measure$ adj3 outcome$).mp. OR (assessment$ adj3 outcome$).mp. OR (research$ adj3 outcome$).mp. OR (stud$ adj3 outcome$).mp. OR (assessment$ adj3 patient$ adj3 outcome$).mp. OR (research$ adj3 patient$ adj3 outcome$).mp. OR exp Risk Reduction Behavior/ OR exp Risk-Taking/ OR exp "Root Cause Analysis"/ OR (cause$ adj3 root$ adj3 analys$).mp. OR exp "Drug-Related Side Effects and Adverse

Database	Search Terms
	Reactions"/ OR (drug$ adj3 side$ adj3 effect$).mp. OR (drug$ adj3 toxic$).mp. OR (drug$ adj3 reaction$ adj3 adverse$).mp. OR (drug$ adj3 event$ adj3 adverse$).mp. OR ae.fs. [adverse effects floating subheading] OR mo.fs. [mortality floating subheading] OR po.fs. [poisoning floating subheading] OR to.fs. [toxicity floating subheading] OR in.fs. [injuries floating subheading]]
Medline In-process	[exp Burnout, Professional/ OR burnout.mp. OR (burnout adj3 effect$).mp.] **AND** [exp Physicians/ OR exp Psychiatry/ OR allergist$.mp. OR anesthesiologist$.mp. OR cardiologist$.mp. OR clinical pharmacologist$.mp. OR clinical toxicologist$.mp. OR dermatologist$.mp. OR doctor$.mp. OR endocrinologist$.mp. OR gastroenterologist$.mp. OR gynecologist$.mp. OR hematologist$.mp. OR immunologist$.mp. OR medical biochemist$.mp. OR medical geneticist$.mp. OR medical microbiologist$.mp. OR nephrologist$.mp. OR neurologist$.mp. OR neuropathologist$.mp. OR neuroradiologist$.mp. OR occupational physician$.mp. OR oncologist$.mp. OR ophthalmologist$.mp. OR pathologist$.mp. OR pediatrician$.mp. OR physician$.mp. OR psychiatrist$.mp. OR radiologist$.mp. OR rheumatologist$.mp. OR surgeon$.mp. OR urologist$.mp.] **AND** [exp Diagnostic Errors/ OR exp Medical Errors/ OR exp Medication Errors/ OR exp "Quality of Health Care"/ OR exp Quality Assurance, Health Care/ OR misdiag$.mp. OR (diagnos$ adj3 error$).mp. OR (medical$ adj3 error$).mp. OR (medication$ adj3 error$).mp. OR (drug$ adj3 error$).mp. OR (mistak$ adj3 medic$).mp. OR (surgic$ adj3 error$).mp. OR (quality$ adj3 health$ adj3 care$).mp. OR (quality$ adj3 healthcare$).mp. OR (quality$ adj3 of adj3 care$).mp. OR exp Professional Competence/ OR (professional$ adj3 competenc$).mp. OR (technical$ adj3 expertise$).mp. OR (expertise$ adj3 generaliz$).mp. OR professionalism$.mp. OR exp Treatment Outcome/ OR (treat$ adj3 outcome$).mp. OR (patient$ adj3 outcome$).mp. OR exp Professional Impairment/ OR (impair$ adj3 physician$).mp. OR (impair$ adj3 doctor$).mp. OR (disruptive$ adj3 behav$).mp. OR exp Safety/ OR safe$.mp. OR exp Risk/ OR risk$.mp. OR exp Patient Satisfaction/ OR (patient$ adj3 satisf$).mp. OR (client$ adj3 satisf$).mp. OR exp Professional-Patient Relations/ OR (professional$ adj3 patient$ adj3 relation$).mp. OR (client$ adj3 contact$).mp. OR exp Physician-Patient Relations/ OR (physician$ adj3 patient$ adj3 relation$).mp. OR (doctor$ adj3 patient$ adj3 relation$).mp. OR exp Communication/ OR communicat$.mp. OR misinform$.mp. OR exp Health Communication/ OR exp "Attitude of Health Personnel"/ OR attitude$.mp. OR exp Clinical Competence/ OR (clinical$ adj3 competenc$).mp. OR (clinical$ adj3 skill$).mp. OR exp Patient-Centered Care/ OR (patient$ adj3 cent$ adj3 care$).mp. OR (patient$ adj3 focus$ adj3 care$).mp. OR exp Empathy/ OR empath$.mp. OR exp Patient Care/ OR (patient$ adj3 care$).mp. OR (informal$ adj3 care$).mp. OR exp "Standard of Care"/ OR (standard$ adj3 care$).mp. OR st.fs. [standards - floating subheading] OR exp Self Efficacy/ OR efficacy$.mp. OR exp Clinical Audit/ OR audit$.mp. OR exp Medical Audit/ OR (diagnos$ adj3 mistak$).mp. OR (medication$ adj3 mistak$).mp. OR (drug$ adj3 mistak$).mp. OR (surgic$ adj3 mistak$).mp. OR exp Safety Management/ OR (program$ adj3 hazard$ adj3 surveillance$).mp. OR (management$ adj3 safety$).mp. OR (hazard$ adj3 control$).mp. OR (hazard$ adj3 management$).mp. OR exp Malpractice/ OR malpractic$.mp. OR negligen$.mp. OR exp Morbidity/ OR morbidit$.mp. OR exp Postoperative Complications/ OR (postoperative$ adj3 complication$).mp. OR exp Cross Infection/ OR (nosocomial$ adj3 infection$).mp. OR (hospital$ adj3 infection$).mp. OR (cross$ adj3 infection$).mp. OR exp Physician's Practice Patterns/ OR (practice$ adj3 pattern$ adj3 clinical$).mp. OR (practice$ adj3 pattern$ adj3 physician$).mp. OR (prescribing$ adj3 pattern$ adj3 physician$).mp. OR (practice$ adj3 pattern$ adj3 professional$).mp. OR (practice$ adj3 pattern$ adj3 variation$).mp. OR (practice$ adj3 clinical$ adj3 variation$).mp. OR (practice$ adj3 medical$ adj3 variation$).mp. OR exp Mortality/ OR (rate$ adj3 age-specific$ adj3 death$).mp. OR (rate$ adj3 death$).mp. OR (rate$ adj3 fatalit$).mp. OR mortalit$.mp. OR exp "Outcome Assessment (Health Care)"/ OR (measure$ adj3 outcome$).mp. OR (assessment$ adj3 outcome$).mp. OR (research$ adj3 outcome$).mp. OR (stud$ adj3 outcome$).mp. OR (assessment$ adj3 patient$ adj3 outcome$).mp. OR (research$ adj3 patient$ adj3 outcome$).mp. OR exp Risk Reduction Behavior/ OR exp Risk-Taking/ OR exp "Root Cause Analysis"/ OR (cause$ adj3 root$ adj3 analys$).mp. OR exp "Drug-Related Side Effects and Adverse Reactions"/ OR (drug$ adj3 side$ adj3 effect$).mp. OR (drug$ adj3 toxic$).mp. OR (drug$ adj3 reaction$ adj3 adverse$).mp. OR (drug$ adj3 event$ adj3 adverse$).mp. OR ae.fs. [adverse effects floating subheading] OR mo.fs. [mortality floating subheading] OR po.fs. [poisoning floating subheading] OR to.fs. [toxicity floating subheading] OR in.fs. [injuries floating subheading]]
PsycINFO	[burnout.mp. OR (burnout adj3 effect$).mp.] **AND** [exp physicians/ OR exp clinicians/ OR exp Psychiatry/ OR allergist$.mp. OR anesthesiologist$.mp. OR cardiologist$.mp. OR clinical pharmacologist$.mp. OR clinical toxicologist$.mp. OR dermatologist$.mp. OR doctor$.mp. OR endocrinologist$.mp. OR gastroenterologist$.mp. OR gynecologist$.mp. OR hematologist$.mp. OR immunologist$.mp. OR medical biochemist$.mp. OR medical geneticist$.mp. OR medical microbiologist$.mp. OR nephrologist$.mp. OR neurologist$.mp. OR neuropathologist$.mp. OR neuroradiologist$.mp. OR occupational physician$.mp. OR oncologist$.mp. OR ophthalmologist$.mp. OR pathologist$.mp. OR pediatrician$.mp. OR physician$.mp. OR psychiatrist$.mp. OR radiologist$.mp. OR rheumatologist$.mp. OR surgeon$.mp. OR urologist$.mp.] **AND** [exp Errors/ OR exp "Quality of Care"/ OR misdiag$.mp. OR (diagnos$ adj3 error$).mp. OR (medical$ adj3 error$).mp. OR (medication$ adj3 error$).mp. OR (drug$ adj3 error$).mp. OR (mistak$ adj3 medic$).mp. OR (surgic$ adj3 error$).mp. OR (quality$ adj3 health$ adj3 care$).mp. OR (quality$ adj3 healthcare$).mp. OR (quality$ adj3 of adj3 care$).mp. OR exp Professional Competence/ OR (professional$ adj3 competenc$).mp. OR (technical$ adj3 expertise$).mp. OR (expertise$ adj3 generaliz$).mp. OR professionalism$.mp. OR exp Treatment Outcome/ OR (treat$ adj3 outcome$).mp. OR (patient$ adj3 outcome$).mp. OR exp Impaired Professionals/ OR (impair$ adj3 physician$).mp. OR (impair$ adj3 doctor$).mp. OR (disruptive$ adj3 behav$).mp. OR exp Safety/ OR safe$.mp. OR exp Risk Factors/ OR exp Risk Management/ OR exp Risk Assessment/ OR risk$.mp. OR exp Client Satisfaction/ OR (patient$ adj3 satisf$).mp. OR (client$ adj3 satisf$).mp. OR exp Therapeutic Processes/ OR (professional$ adj3 patient$ adj3 relation$).mp. OR (client$ adj3 contact$).mp. OR (physician$ adj3 patient$ adj3 relation$).mp. OR (doctor$ adj3 patient$ adj3 relation$).mp. OR exp Communication/ OR communicat$.mp. OR misinform$.mp. OR exp Communication Skills/ OR exp Communication Barriers/ OR exp Health Personnel Attitudes/ OR attitude$.mp. OR exp Competence/ OR (clinical$ adj3 competenc$).mp. OR (clinical$ adj3 skill$).mp. OR exp Client Centered Therapy/ OR (patient$ adj3 cent$ adj3 care$).mp. OR (patient$ adj3 focus$ adj3 care$).mp. OR exp Empathy/ OR empath$.mp. OR exp Patients/ OR (patient$ adj3 care$).mp. OR (informal$ adj3 care$).mp. OR exp Professional

Database	Search Terms
	Standards/ OR (standard$ adj3 care$).mp. OR exp Self Efficacy/ OR efficacy$.mp. OR exp Clinical Audits/ OR audit$.mp. OR (diagnos$ adj3 mistak$).mp. OR (medication$ adj3 mistak$).mp. OR (drug$ adj3 mistak$).mp. OR (surgic$ adj3 mistak$).mp. OR (program$ adj3 hazard$ adj3 surveillance$).mp. OR (management$ adj3 safety$).mp. OR (hazard$ adj3 control$).mp. OR (hazard$ adj3 management$).mp. OR exp Professional Liability/ OR malpractic$.mp. OR negligen$.mp. OR exp Morbidity/ OR morbidit$.mp. OR exp Postoperative Complications/ OR (postoperative$ adj3 complication$).mp. OR (nosocomial$ adj3 infection$).mp. OR (hospital$ adj3 infection$).mp. OR (cross$ adj3 infection$).mp. OR exp Clinical Practice/ OR (practice$ adj3 pattern$ adj3 clinical$).mp. OR (practice$ adj3 pattern$ adj3 physician$).mp. OR (prescribing$ adj3 pattern$ adj3 physician$).mp. OR (practice$ adj3 pattern$ adj3 professional$).mp. OR (practice$ adj3 pattern$ adj3 variation$).mp. OR (practice$ adj3 clinical$ adj3 variation$).mp. OR (practice$ adj3 medical$ adj3 variation$).mp. OR exp Mortality Rate/ OR exp "Death and Dying"/ OR (rate$ adj3 age-specific$ adj3 death$).mp. OR (rate$ adj3 death$).mp. OR (rate$ adj3 fatalit$).mp. OR mortalit$.mp. OR exp Treatment Effectiveness Evaluation/ OR (measure$ adj3 outcome$).mp. OR (assessment$ adj3 outcome$).mp. OR (research$ adj3 outcome$).mp. OR (stud$ adj3 outcome$).mp. OR (assessment$ adj3 patient$ adj3 outcome$).mp. OR (research$ adj3 patient$ adj3 outcome$).mp. OR exp Risk-Taking/ OR exp Error Analysis/ OR (cause$ adj3 root$ adj3 analys$).mp. OR exp "Side Effects (Drug)"/ OR (drug$ adj3 side$ adj3 effect$).mp. OR (drug$ adj3 toxic$).mp. OR (drug$ adj3 reaction$ adj3 adverse$).mp. OR (drug$ adj3 event$ adj3 adverse$).mp. OR exp Toxic Disorders/ OR exp Injuries/ OR 3620.cc. [Personnel Management & Selection & Training classification code] OR 3630.cc. [Personnel Evaluation & Job Performance classification code] OR 3650.cc. [Personnel Attitudes & Job Satisfaction classification code] OR 3670.cc. [Working Conditions & Industrial Safety classification code] OR 3430.cc. [Professional Personnel Attitudes & Characteristics classification code] OR 3450.cc. [Professional Ethics & Standards & Liability code] OR 3470.cc. [Impaired Professionals classification code]]
Embase	[exp Burnout/ OR burnout.mp. OR (burnout adj3 effect$).mp.] **AND** [exp Physicians/ OR exp Psychiatry/ OR allergist$.mp. OR anesthesiologist$.mp. OR cardiologist$.mp. OR clinical pharmacologist$.mp. OR clinical toxicologist$.mp. OR dermatologist$.mp. OR doctor$.mp. OR endocrinologist$.mp. OR gastroenterologist$.mp. OR gynecologist$.mp. OR hematologist$.mp. OR immunologist$.mp. OR medical biochemist$.mp. OR medical geneticist$.mp. OR medical microbiologist$.mp. OR nephrologist$.mp. OR neurologist$.mp. OR neuropathologist$.mp. OR neuroradiologist$.mp. OR occupational physician$.mp. OR oncologist$.mp. OR ophthalmologist$.mp. OR pathologist$.mp. OR pediatrician$.mp. OR physician$.mp. OR psychiatrist$.mp. OR radiologist$.mp. OR rheumatologist$.mp. OR surgeon$.mp. OR urologist$.mp.] **AND** [exp Diagnostic Errors/ OR exp Medical Errors/ OR exp Medication Errors/ OR exp Health care quality/ OR exp Quality control/ OR misdiag$.mp. OR (diagnos$ adj3 error$).mp. OR (medical$ adj3 error$).mp. OR (medication$ adj3 error$).mp. OR (drug$ adj3 error$).mp. OR (mistak$ adj3 medic$).mp. OR (surgic$ adj3 error$).mp. OR (quality$ adj3 health$ adj3 care$).mp. OR (quality$ adj3 healthcare$).mp. OR (quality$ adj3 of adj3 care$).mp. OR exp Professional Competence/ OR (professional$ adj3 competenc$).mp. OR (technical$ adj3 expertise$).mp. OR (expertise$ adj3 generaliz$).mp. OR professionalism$.mp. OR exp Treatment Outcome/ OR (treat$ adj3 outcome$).mp. OR (patient$ adj3 outcome$).mp. OR exp Malpractice/ OR (impair$ adj3 physician$).mp. OR (impair$ adj3 doctor$).mp. OR (disruptive$ adj3 behav$).mp. OR exp Safety/ OR safe$.mp. OR exp Risk OR exp Risk Factors/ OR exp Risk Assessment/ OR exp Risk Management/ OR risk$.mp. OR exp patient satisfaction/ OR (patient$ adj3 satisf$).mp. OR (client$ adj3 satisf$).mp. OR exp human relation/ OR (professional$ adj3 patient$ adj3 relation$).mp. OR (client$ adj3 contact$).mp. OR exp doctor patient relation/ OR (physician$ adj3 patient$ adj3 relation$).mp. OR (doctor$ adj3 patient$ adj3 relation$).mp. OR exp interpersonal communication/ OR communicat$.mp. OR misinform$.mp. OR exp communication disorder/ OR exp communication skill/ OR exp health personnel attitude/ OR attitude$.mp. OR exp clinical competence/ OR (clinical$ adj3 competenc$).mp. OR (clinical$ adj3 skill$).mp. OR exp patient care/ OR (patient$ adj3 cent$ adj3 care$).mp. OR (patient$ adj3 focus$ adj3 care$).mp. OR exp Empathy/ OR empath$.mp. OR exp medical care/ OR (patient$ adj3 care$).mp. OR (informal$ adj3 care$).mp. OR exp professional standard/ OR (standard$ adj3 care$).mp. OR exp standard/ OR exp Self Efficacy/ OR efficacy$.mp. OR exp medical audit/ OR audit$.mp. OR (diagnos$ adj3 mistak$).mp. OR (medication$ adj3 mistak$).mp. OR (drug$ adj3 mistak$).mp. OR (surgic$ adj3 mistak$).mp. OR (program$ adj3 hazard$ adj3 surveillance$).mp. OR (management$ adj3 safety$).mp. OR (hazard$ adj3 control$).mp. OR (hazard$ adj3 management$).mp. OR malpractic$.mp. OR negligen$.mp. OR exp Morbidity/ OR morbidit$.mp. OR exp postoperative complication/ OR (postoperative$ adj3 complication$).mp. OR exp Cross Infection/ OR (nosocomial$ adj3 infection$).mp. OR (hospital$ adj3 infection$).mp. OR (cross$ adj3 infection$).mp. OR exp clinical practice/ OR exp professional practice/ OR (practice$ adj3 pattern$ adj3 clinical$).mp. OR (practice$ adj3 pattern$ adj3 physician$).mp. OR (prescribing$ adj3 pattern$ adj3 physician$).mp. OR (practice$ adj3 pattern$ adj3 professional$).mp. OR (practice$ adj3 pattern$ adj3 variation$).mp. OR (practice$ adj3 clinical$ adj3 variation$).mp. OR (practice$ adj3 medical$ adj3 variation$).mp. OR exp mortality/ OR exp death/ OR (rate$ adj3 age-specific$ adj3 death$).mp. OR (rate$ adj3 death$).mp. OR (rate$ adj3 fatalit$).mp. OR mortalit$.mp. OR exp outcome assessment/ OR (measure$ adj3 outcome$).mp. OR (assessment$ adj3 outcome$).mp. OR (research$ adj3 outcome$).mp. OR (stud$ adj3 outcome$).mp. OR (assessment$ adj3 patient$ adj3 outcome$).mp. OR (research$ adj3 patient$ adj3 outcome$).mp. OR exp risk reduction/ OR exp high risk behavior/ OR exp "root cause analysis"/ OR (cause$ adj3 root$ adj3 analys$).mp. OR exp adverse drug reaction/ OR (drug$ adj3 side$ adj3 effect$).mp. OR (drug$ adj3 toxic$).mp. OR (drug$ adj3 reaction$ adj3 adverse$).mp. OR (drug$ adj3 event$ adj3 adverse$).mp. OR ae.fs. [adverse drug reaction] OR to.fs. [drug toxicity] OR dt.fs. [drug interaction subheading] OR si.fs. [side effect subheading] OR co.fs. [complication subheading]]
Web of Science	[burn out* OR burnout*] **AND** [physician* OR clinician* OR psychiatry* OR allergist* OR anesthesiologist* OR cardiologist* OR clinical pharmacologist* OR clinical toxicologist* OR dermatologist* OR doctor* OR endocrinologist* OR gastroenterologist* OR gynecologist* OR hematologist* OR immunologist* OR medical biochemist* OR medical geneticist* OR medical microbiologist* OR nephrologist* OR neurologist* OR neuropathologist* OR neuroradiologist* OR occupational physician* OR oncologist* OR

Database	Search Terms
	ophthalmologist* OR pathologist* OR pediatrician* OR physician* OR psychiatrist* OR radiologist* OR rheumatologist* OR surgeon* OR urologist* OR consultant*] **AND** [error* OR health* care*OR healthcare* OR quality* OR misdiag* OR mistak* OR competenc* OR expertis* OR professionalism* OR outcome* OR impair* OR disruptive* OR safe* OR risk* OR satisf* OR relation* OR contact* OR communicat* OR misinform* OR attitude* OR skill* OR care* OR empath* OR standard* OR audit* OR hazard* OR malpractic* OR negligen* OR morbidit* OR infection* OR practice* pattern* OR prescrib* pattern* OR mortalit* OR death* OR fatalit* OR drug* OR adverse* OR poison* OR toxic* OR injur*]

Screening process

Relevant articles were identified using a multi-phase screening process using the inclusion and exclusion criteria for this review. In the first step, titles were screened. Next, abstracts of the articles that remained after the first step were screened. The final step of the process involved screening the full text of all articles that passed the first and second phases. In the full text screening, papers for which there was insufficient information in the title and abstract to determine relevancy were also included. Two reviewers (CSD and LT) independently completed the multi-phase screening process. The inter-rater reliability corrected for chance[24] between CSD and LT was $\kappa = 0.96$. Before moving onto each stage, disagreements were discussed until consensus was reached.

For this review, burnout was defined as a syndrome of emotional exhaustion, cynicism (depersonalization) and reduced feelings of personal accomplishment related to work.[6] Quality of care related to acceptability was identified with measures reflecting physician-patient interactions such as patient satisfaction, perceived quality of care, physician communication with patients, and physician attitudes towards patients. In addition, safety was identified by measures of medical errors.

Study inclusion criteria were:

1. Studies reported quality of care outcomes related to acceptability and/or safety
2. The sample population was comprised of practicing physicians regardless of specialty who worked in civilian settings
3. Burnout was assessed based on a psychometrically validated measure

4. Paper reports original research

Exclusion criteria were:

1. The study sample was comprised only of residents and medical students
2. The study did not examine the relationship between burnout and one of the two quality of care dimensions
3. Burnout was not assessed based on a validated measure
4. The paper was a review article or commentary

Risk of Bias Assessment

All included articles were assessed for risk of bias by both reviewers (CSD and LT). Disagreements between the two reviewers were discussed until consensus was reached.

To assess the risk of bias in observational studies, Sanderson et al.[25] recommend the use of a transparent checklist that concentrates on the "few, principal, and potential sources of bias in a study's findings". They assert that the fundamental domains should include: (1) the appropriate selection of participants, (2) appropriate measurement of variables, and (3) appropriate control of confounding. In accordance with their recommendations and the Strengthening of Observational Studies in Epidemiology (STROBE) criteria,[26] a 9-item quality checklist with the following criteria adapted from Lagerveld et al.[27] was used:

1. Study population is well described to facilitate understanding about the generalizability of the results based on the study sample (e.g., age, sex, location of the study, physician specialty, practice location)
2. Data collection methods that address the risk of bias are described
3. Participation/response rate was at least 50% on average
4. Quality of care outcome was clearly defined
5. Statistical method was appropriate for the question being answered
6. Statistical significance of associations were tested and reported
7. Study controlled for at least one confounder such as sex or age was considered in the analyses

8. Physician matched with patient
9. Longitudinal data was used

Each item was scored "1" if the criterion had been met. Each article could achieve a minimum score of 8. Based on their total score, articles were categorized either as high (9-8 points), moderate (7-5 points), or low quality (1-4 points).

RESULTS

Article Inclusion and Exclusion Results

The electronic literature search resulted in the identification of 3,255 unique citations (Figure 1). Based on the title review, 3,168 citations were excluded; this left 87 articles for abstract review. During the abstract review, another 26 citations were excluded; this left 61 articles for full-text review. Reasons for article exclusions at full text review were: (1) not a relevant outcome (n = 10), (2) sample not comprised of physicians/cannot distinguish physicians as a group from other clinicians (n = 14), (3) it was not original research (n = 19), (4) burnout not measured with a validated instrument (n = 1), and (5) not published in a peer-reviewed journal (n = 7). After the full-text review, 10 articles remained and their reference lists were hand searched for relevant studies. The hand search identified six additional citations; all six were excluded at full text review.

Insert Figure 1

Risk of Bias Assessment Results

Our assessment indicated 9 of the 10 studies were of moderate risk of bias; one was of low risk of bias. Figure 2 illustrates the limitations of these studies. Only one study comprehensively[5] described the study population from which the study sample was drawn. Only

one study used longitudinal data.[28] Other limitations involved not reporting the response rate[29-32] and not controlling for possible confounding factors in the statistical analyses.[32,33] All included studies clearly defined the quality of care measure used, employed appropriate statistical tests, and reported the results of the statistical testing. (Supplementary File 1: Risk of Bias Assessment Checklist)

Insert Figure 2

Overview of the Studies

Of the 10 studies that met the inclusion criteria (Table 2), three were conducted in the US, two in Germany, one each in Greece, Israel, Japan, and Taiwan. There was one multi-national study based on data from Italy, Spain, and Portugal.

Table 2. Description of the Studies

Author(s)	Study Population	Description of Sample	Burnout Measure	Quality of Care Measure
Agagnostopoulos et al. (2012)[29] Greece	Physicians working in three large primary health care centers. Patients of participating physicians. Patients selected through systematic random sampling – 1:3 consecutive patients. Physician response rate: 85.8% Patient response rate: Not reported	n = 30 physicians ≤ 10 years practicing: 53% Specialties: General practitioners: 63% Pathologists/internists: 23.3% Male: n=17 Female: n=13 > 50 yrs: 43% 26-50 yrs: 40% n = 300 patients Male: 46% Female: 54% Mean age: 54 ± 15 yrs	22-item Maslach Burnout Inventory	Patient report: Patient satisfaction assessed using 18-item Consultation Satisfaction Questionnaire.[34] 5-point Likert scale from 1 = "strongly agree" to 5 = "strongly disagree". Satisfaction sub-scales: (1) General, (2) Perceived length of consultation, (3) Depth of relationship, (4) Professional care provided Overall satisfaction: sum of all items (max score = 90)

Author(s)	Study Population	Description of Sample	Burnout Measure	Quality of Care Measure
Halbesleben and Rathert (2008)[30] USA	Attending physicians of university students who had been hospitalized in past year. Student response rate: Not reported	n = 178 physicians Yrs practicing: Not reported Specialties: Not reported Male: n = 84 Female: n = 94 Mean age = 46 ± 13 yrs n = 178 patients Male: n = 98 Female: n = 80 Mean age: 23 ± 5 yrs	22-item Maslach Burnout Inventory modified to apply to patients rather than general care recipients	Patient report: Patient satisfaction assessed using 22-item SERVQUAL.[35] 7-point Likert scale from 1 = "strongly disagree" to 7 = "strong agree".
Hayashino et al. (2012)[28] Japan	Members of a panel of 6,459 hospital-based physicians recruited through hospital lists and scientific meetings. A randomly selected sub-sample of 1,198 were invited to participate. Response rate: 70%	n = 836 physicians Yrs practicing: Not reported Male: 92% Female: 8% 28-39 yrs: 23% 40-49 yrs: 47% 50-59 yrs: 26% 60-81 yrs: 4%	17-item Maslach Burnout Inventory developed for Japanese healthcare professionals Used burnout thresholds: EE: ≥ 21 DP: ≥ 18 PA: ≥ 16	Physician report: Perceived medical errors assessed with questions: "Are you concerned that you have made any major medical mistakes in the last year?" IF "yes", asked about number of medical errors that concerned respondent.
Klein et al. (2010)[5] Germany	Physicians in surgery working in > 100 beds general hospitals with a general surgical and/or gynecological ward. Stratified probability sample based on hospital beds. Response rates: Hospital level: 53% Physician level: 36% Physicians in participating hospitals: 65%	n = 1,311 physicians Mean yrs practicing: 11yrs Male: 60% Female: 40% Mean age = 45 ± 8.5 yrs	Copenhagen Burnout Inventory (CBI). Three scales assessing personal, client, and work burnout. This study focused on personal burnout (i.e., degree of physical and psychological fatigue and exhaustion).	Physician report: Perceived quality of care assessed using short version of Chirurgisches Qualitätssiegel. Created three sub-scales: (1) psychosocial care, (2) diagnosis/therapy, (3) quality assurance. 5-point Likert scale from 1 = "very good" to 5 = "bad". Two questions about frequency of diagnostic and therapeutic errors: "I have made mistakes is diagnosis." and "I have made mistakes in treatment." 4-point Likert scale ("never" to "often").

Author(s)	Study Population	Description of Sample	Burnout Measure	Quality of Care Measure
Ratanawongsa et al. (2008)[31] USA	Physicians from 15 urban community-based clinics who provided primary care to adult patient enrolled in a randomized controlled trial for hypertensize minority patient. Response rate: Not reported	n = 40 physicians Mean years of practice: 11 ± 7.7 yrs Male: 47% Female: 53% Mean age: 42 ± 8.7 yrs Specialities: Internal Medicine: 83% Family Practice: 15% General Practice: 2% n = 235 patients Male: 34% Female: 66% Mean age: 59 ± 13.2 yrs	A 6-item scale derived from the Maslach Burnout Inventory that captures the domain of EE and PA. Five point Likert scale from 1 = "strongly agree" to 3 = "neutral" to 5 = "strongly agree". Based on terciles, burnout scores were categorized as low, average, high.	Physician report: Physicians completed "brief questionnaires indicating the degree to which they knew the patient, their attitudes toward the patient in general, and their attitudes regarding the visit". Audiotaped encounters analyzed for rapport-building communication behaviors using the Roter Interaction Analysis System. Four types of rapport identified: (1) Positive, (2) Negative, (3) Emotional, (4) Social
Shanafelt et al. (2010[36] USA	American surgeons who were members of the American College of Surgeons who permitted email correspondence. Response rate: 32%	n = 7,905 physicians Specialty: General: 41% Cardiothoracic: 6% Colorectal: 4% Otolaryngology: 5% Obstetrics/gynecology: 1% Oncologic: 5% Pediatric: 2% Plastic: 4% Transplant: 2% Trauma: 4% Urologic: 4% Vascular: 6% Other: 6% Male: 87% Female: 13% Median age (IQR): 51 yrs (43, 59)	22-item Maslach Burnout Inventory	Physician response to: "Are you concerned you have made any major medical error in the last 3 months?"
Shirom et al. (2006)[37] Israel	Physicians from 4 health plans specializing in either: ophthalmology, dermatology, otolaryngology, gynecology (community-based), general surgery, cardiology (hospital-based). 50% random probability sample drawn from each specialty. Response rate: 63%	n = 890 physicians Male: 80% Female: 20% Median age: 52 yrs	12-items from the Shirom-Melamed Burnout Measure with 3 sub-scales: (1) physical fatigue, (2) cognitive weariness, (3) emotional exhaustion	Physicians completed a 15-item version of the SERVQUAL patient satisfaction scale. 5-point Likert scale from 1 = "to a very small extent" to 5 = "to a very large extent".

Author(s)	Study Population	Description of Sample	Burnout Measure	Quality of Care Measure
Travado et al. (2005)[32] Italy, Spain, Portugal	Physicians recruited from cancer centers of three hospitals – two general hospitals with a cancer ward and one cancer hospital. Convenience sample Response rate: Not reported	n = 125 physicians Yrs of practice: 15 ± 9.4 yrs Male: 47% Female: 54% Mean age: 42 ± 9.7 yrs	22-item Maslach Burnout Inventory Used Maslach and Jackson (1986) cutoff scores for no/low burnout, intermediate, and high burnout	Communication skills assessed using two scales: (1) Self-Confidence in Communications Skills (SCSS). 12-item scale rating ability to communicate and manage a series of clinical situations. (2) Expected Outcomes of Communication (EOC). 23-item scale assessing extent to which physician perceives result of communication is positive or negative.
Weigl et al. (2015)[38] Germany	Physicians working in one academic children's hospital who were providing patient care. Response rate: 74%	n = 88 physicians Yrs of practice: 8 ± 6.7 yrs Male: 47% Female: 53% Mean age: 37 ± 8.6 yrs	Two sub-scales of the Maslach Burnout Inventory: Emotional Exhaustion and Depersonalization. High burnout defined as Mean EE score > 3.5 and Mean DP > 2.5	2-item perceived quality of care measure: "My workload frequently leads to reduced quality of work" and "Adverse work conditions frequently lead to a loss of quality." 5-point Likert scale from 1 = "not at all" to 5 = "a very great extent".
Weng et al. (2011)[33] Taiwan	Physicians working in two hospitals. Patients of participating physicians. Physician response rate: Not reported Patient response rate: 78%	n = 110 internists Male: 85% Female: 15% Mean age: 41 ± 6.9 yrs n = 2,872 patients Male: 59% Female: 41%	Maslach Burnout Inventory	Patient satisfaction assessed with two questions: "I am satisfied with the care provided by my doctor" and "I would recommend this doctor to my friends and family members".

Description of the Study Populations

Five of the studies focused on hospital-based physicians.[5,28,32,33,38] Among these studies, two focused on cancer[32] and children's[38] specialty hospitals. In addition, one of these studies recruited surgeons practicing either in general surgery or gynecological wards.[5]

The remaining five studies recruited physicians practicing in a variety of settings. Two studies sought physicians in primary health care centers;[29,31] they included physicians practicing in internal medicine, general practice, and family practice. Two studies did not specify the setting.[30,36] However, of these two, one focused on surgeons.[36] Finally, one study used four

health plans to recruit and contained a mixture of community and hospital physicians[37] which included physicians specializing in ophthalmology, dermatology, otolaryngology, community-based gynecology, general surgery, and hospital-based cardiology.

Measuring Burnout

In eight of the 10 studies, burnout was measured using the 22-item Maslach Burnout Inventory (MBI)[6] or selected MBI sub-scales.[27-33,36,38] The complete 22-item MBI measures three dimensions of burnout: Emotional Exhaustion, Depersonalization and Personal Accomplishment. It is one of the most widely used measures of burnout in the scientific literature.[39,40]

The two remaining studies used the Copenhagen Burnout Inventory (CBI)[39] and the Shirom-Melamed Burnout Measure (SMBM).[40,41] The CBI is a 19-item scale comprised of three sub-scales that assess personal burnout, work-related burnout, and client-related burnout.[39] It has been shown to be correlated with mental and general health as well as job satisfaction.[39] The SMBM is a 22-item measure with three sub-scales that assess physical fatigue, emotional exhaustion, and cognitive weariness.[40] The psychometric properties of these scales continue to be explored.[40,42,43]

Measuring Quality of Care related to Acceptability and Patient Safety

Four types of quality of care measures related to acceptability and safety were used in these studies. In terms of patient safety, medical errors were measured. Acceptability related measures included patient satisfaction, perceived general quality of care, and physician communication/attitudes.

Patient Safety Measures: Medical errors

Patient safety was examined with medical errors. This outcome was assessed in three studies.[5,28,36] Hayashino et al.[28] and Shanafelt et al.[36] used similar questions about whether the respondent made major medical errors. However, the studies differed in the time frame that the respondent was asked to consider. Hayashino et al.[28] asked about the past year while Shanafelt et al.[36] inquired about the past three months. In contrast to these studies, Klein et al.[5] asked about frequency of diagnostic mistakes and treatment without specifying a time frame. The first two studies seem to emphasize *major* errors rather than *any* errors. In addition to questions about frequency of diagnostic mistakes and treatment, Klein et al.[5] included a questionnaire based on the Canadian Physician Achievement Review to evaluate physician self-perceived quality of psychosocial care, diagnosis/therapy, and quality assurance.[44]

Acceptability Measures: Patient satisfaction/Perceived Quality of Care

With regard to acceptability measures, patient satisfaction was assessed in four studies.[29,30,33,37] In two of these studies, the SERVQUAL was used to measure patient satisfaction/quality of care.[30,37] The SERVQUAL was developed to measure service quality along five dimensions: (1) tangibles (i.e., physical facilities), (2) Reliability (i.e., performs dependably and accurately), (3) responsiveness (i.e., willingness to help), (4) assurance (i.e., ability to inspire trust), and (5) empathy (i.e., caring).[45] Halbesleben and Rathert[30] used a healthcare specific version of the SERVQUAL. Shirom and colleagues[37] adapted the SERVQUAL by dropping 7 items and revising the language for physicians to rate their own quality of care using the remaining 15 items.

Weigl et al.[38] looked at physician-perceived quality of care by asking physicians to rate two statements on a 5-point scale, “My workload frequently leads to reduced quality of work,”

and "Adverse work conditions frequently lead to a loss of quality."

One study[29] used the Consultation Satisfaction Questionnaire (CSQ) scale that was created to assess patient satisfaction with general practitioners.[34] It is comprised of 18 items and measures satisfaction along four dimensions: general satisfaction, professional care, depth of relationship, and perceived time.

Finally, in their study, Weng et al.[33] used two questions to indicate patient satisfaction, "I am satisfied with the care provided by my doctor," and "I would recommend this doctor to my friends and family." The first of Weng et al.'s[33] question is similar to one of the CSQ's[34] general satisfaction items, "I am totally satisfied with my visit to the doctor." A version of the second question has been used to measure satisfaction and was correlated with the EUROPEP patient satisfaction questionnaire.[46]

Acceptability Measures: Communication/Attitudes

Two studies focused on physician communication/attitudes.[31,32] Using audiotapes of physician/patient interactions, Ratanawongsa et al.[31] assessed the interactions by employing the Roter Interaction Analysis System (RIAS).[47] RIAS is a validated method of categorizing these interactions into three categories related either to content, affection, or process.[48] There is evidence that there is an association between the content and the socioemotional nature of the interactions as categorized using the RIAS and patient satisfaction.[47,48]

Travado et al.[32] examined the association between burnout and communication using two measures: the Self-Confidence in Communications Skills (SCSS) and the Expected Outcomes of Communication (EOC).[49] In their article, Parle and colleagues[49] note that exploration of the psychometric properties of both measures were being conducted. Both were developed to understand the communication skills of physicians working with cancer patients.

Study Outcomes: Burnout and Quality of Care

In this sub-section, we report the quality of care outcomes from the included studies (Table 3). This review of outcomes begins by reporting findings regarding the association between burnout and patient safety (i.e., medical errors). It is followed by reporting of the acceptability outcomes as measured by patient satisfaction/perceived quality of care and physician communication/attitudes.

Outcomes: Burnout and Medical Errors

Table 3 contains the outcomes reported by the included papers. In terms of findings for the association between burnout and medical errors, there was a consistently significant relationship between burnout and medical errors among the three papers focusing on this relationship.[5,28,36] Shanafelt et al.[36] reported significantly higher odds of a major medical error during the past three months among physicians with higher EE and DP but lower odds among physicians with higher PA. Hayashino et al.[28] also observed significant associations between a major medical error during the past 12 months and higher levels of EE and DP; however, the relationship with PA was not significant. Klein et al.[5] reported significant associations between high burnout and diagnostic error, therapeutic error, sub-optimal psychosocial care, sub-optimal diagnosis and treatment, and sub-optimal quality assurance.

Table 3. Patient Safety and Acceptability Related Quality of Care Outcomes

	Patient Safety Outcomes	Acceptability Outcomes	
Author(s)	**Medical Errors (ME)**	**Patient Satisfaction (PS)/ Perceived Quality of Care (QoC)**	**Communication/Attitudes**
Agagnostopoulos et al. (2012)[29] Greece		Correlation btwn Maslach Burnout Inventory (MBI) dimensions and PS: • EE & PS: r = -0.64, p<0.01 • DP & PS: r = -0.54, p<0.01 • PA & PS: r = 0.26, p=0.17 Results of mixed effect model with PS as outcome: • Low EE associated with highest average PS Comparison btwn moderate and high EE no significant difference in association with PS	
Halbesleben and Rathert (2008)[30] USA		Correlation btwn MBI dimensions and PS: DP & PS: r = -0.16, p<0.05	
Hayashino et al. (2012)[28] Japan	Association btwn MBI dimensions and any medical error: • Significant differences among tertiles for EE (p=0.026) & DP (p=0.002) % with ME by burnout dimension tertile: EE 1st tertile: 27.9% EE 2nd tertile: 38.2% EE 3rd tertile: 33.9% DP 1st tertile: 35.0% DP 2nd tertile: 27.8% DP 3rd tertile: 37.2% • No significant differences among tertiles for PA (p=0.67)		
Klein et al. (2010)[5] Germany	Adjusted* Odds Ratios (95% CI) for probability of error and high burnout score: • Diagnostic error: OR = 1.66 (1.26, 2.20) • Therapeutic error: OR = 1.94 (1.39, 2.69) *Adjusted for gender, occupational position, job experience	Adjusted* Odds Ratios (95% CI) for probability of suboptimal care and high burnout score: • Psychosocial care: OR = 1.58 (1.19, 2.10) • Dx/Tx: OR = 1.59 (1.17, 2.16) • Quality assurance: OR = 1.45 (1.10, 1.90) *Adjusted for gender, occupational position, job experience	

	Patient Safety Outcomes	Acceptability Outcomes	
Author(s)	**Medical Errors (ME)**	**Patient Satisfaction (PS)/ Perceived Quality of Care (QoC)**	**Communication/Attitudes**
Ratanawongsa et al. (2008)[31] USA		Adjusted* Odds Ratios (95% CI) for probability of PS with high vs low burnout: • PS: OR = 0.44 (0.18, 1.08), p=0.07 *Adjusted for patient health insurance, visit length, physician gender, physician IMG status, interaction btwn IMG status and burnout	Odds Ratios (95% CI) for probability of negative rapport building with medium and high vs low burnout: • Medium: OR = 1.85 (1.31, 2.61), p=0.001 • High: OR = 2.06 (1.58, 2.86), p<0.001 *Adjusted for patient health insurance, visit length, physician gender, physician IMG status, interaction btwn IMG status and burnout
Shanafelt et al. (2010)[36] USA	Odds Ratios (95% CI) for perceived medical error with MBI dimensions: • EE: OR = 1.048 (1.042, 1.055), p<0.0001 • DP: OR = 1.109 (1.096, 1.122), p<0.0001 • PA: OR = 0.965 (0.955, 0.975), p<0.0001		
Shirom et al. (2006)[37] Israel		Structural equation model examining relationships of autonomy, burnout and QoC: • Relationship btwn global burnout and QoC not significant (β = -0.12, p>0.05) • EE exhaustion negatively related to QoC (β = -0.40, p<0.05)	
Travado et al. (2005)[32] Italy, Spain, Portugal			Correlations btwn MBI burnout dimensions and communication: Self-Confidence in Communication Skills • EE: r = -.03, not significant • DP: r = -0.08, not significant • PA: r = 0.37, p<0.01 Negative Expected Outcomes of Communication • EE: r = -0.21, p<0.05 • DP: r = -0.25, p<0.01 • PA: r = 0.28, p<0.01 Positive Expected Outcomes of Communication • EE: r = 0.01, not significant • DP: r = 0.34, p<0.01 • PA: r = -0.28, p<0.01

	Patient Safety Outcomes	Acceptability Outcomes	
Author(s)	**Medical Errors (ME)**	**Patient Satisfaction (PS)/ Perceived Quality of Care (QoC)**	**Communication/Attitudes**
Weigl et al. (2015)[38] Germany		Adjusted* Odds Ratios (95% CI) for probability of low QoC with MBI dimensions (Low vs High): • EE: OR = 0.75 (0.08, 1.42), p<0.05 • DP: OR = 0.17 (-0.45, 0.80), not significant *Adjusted for gender, professional tenure, clinical work environment, career stage/position	
Weng et al. (2011)[33] Taiwan		Correlation btwn MBI burnout dimensions and PS: • EE: not significant • DP: negative relationship (p<0.01) • PA: not significant	

Outcomes: Burnout and Patient Satisfaction/Quality of Care

Among the four studies that examined the relationship between burnout and patient satisfaction/quality of care, three observed a significant relationship between either burnout or at least one dimension of burnout.[29-31,33] The one study[31] that combined the MBI EE and PA dimensions to create a single burnout score did not find a significant relationship between the score and patient satisfaction. Because it used only two subscales and one of them was PA rather than DP, it is not clear regarding the extent to which their choice of sub-scales was consistent with the other measures of burnout.

Among the three studies that reported separate MBI dimensions, there seemed to be a consistent observation that high DP is significantly related to lower patient satisfaction.[29,30,33] However, the significance of the association between EE and patient satisfaction varied among studies; Agagnostopoulos et al.[29] reported a significant correlation but Weng et al.[33] did not.

At the same time, Shirom et al.[37] described a significantly negative relationship between high EE and physician perceived quality of care. Weigl and colleagues[38] also found a significant

negative relationship with EE but did not find a significant relationship between DP and physician perceived quality of care.

Outcomes: Burnout and Communication/Attitudes

Travado et al.[32] found a significantly positive relationship between PA and self-confidence in communication skills as well as with negative expected outcomes of communication. They also observed a significantly negative association between PA and positive expected outcomes of communication. In addition, Ratanawongsa et al.[31] reported a higher probability of negative rapport with medium and high burnout.

DISCUSSION

This systematic literature review identified 10 studies of which nine had a moderate risk of bias and one with a low risk of bias. The results of these physician burnout studies show that patient safety has been primarily measured by examining medical errors. The acceptability outcomes have been captured using two groups of indicators that measure patient satisfaction/perceived quality of care and physician communication/attitudes towards patients. The majority of these studies examined the relationship between burnout and acceptability. Among the acceptability-related quality of care outcomes, the focus has been on patient satisfaction/perceived quality of care.

The results of the three included studies that reported on the relationship between burnout and medical errors suggest there is evidence that burnout is associated with physician self-perceived medical errors and sub-optimal care. However, there is equivocal evidence that specific dimensions of burnout are related to the acceptability dimension of quality of care as measured by patient satisfaction, perceived quality of care, or physician communication/attitudes. Thus, the current body of evidence suggests there is moderate

evidence for the association between burnout and safety aspects of healthcare whereas the evidence is weaker for the patient-related acceptability aspects of quality.

Strengths and Limitations of Interpreting the Literature

One of important questions raised by burnout studies in general is highlighted by Klein et al.'s[5] and Shirom et al.'s[37] use of non-MBI scales. Klein and colleagues[5] used the Copenhagen Burnout Inventory while Shirom et al.[37] used the Shirom-Melamed Burnout Measure. One of criticisms that the separate developers of these two scales raise is that the MBI does not fully assess burnout.[37,39] Rather, both groups argue that fatigue and exhaustion are fundamental to the definition of burnout.[37,39] However, this emphasis on exhaustion may be reflected in the fact that EE is the most widely studied of the MBI dimensions.[50] This would argue for the assessment of this dimension in studies of burnout and the individual reporting of it.

Another limitation of these studies was the reliance on physician self-report data for the assessment of medical errors. The self-report could be influenced by a number of factors including recall bias and social desirability. There is a potential additional bias introduced if self-report is used for both the outcome and the problem.[51] The presence of burnout could also influence perceptions. For example, Fahrenkopf et al.[52] observed a discrepancy between the results of chart audits and physician self-report; those with higher burnout scores reported higher numbers of medical errors than the chart audits would suggest.

An alternative to self-report would be observational data. However, watching physicians while they practiced could lead to a Hawthorne Effect. Another alternative would be to review medical records to identify errors. But, this relies on the accuracy of the records. Also, it is not clear what types of medical errors should be assessed – major errors leading to an adverse event or any medical error regardless of outcome? In their study, Fahrenkopf et al.[52] used a

standardized method to abstract information from charts and trained reviewers to categorize the errors into groups: (1) preventable adverse event, (2) non-preventable adverse event, (3) potential adverse event, and (4) error with little potential for harm. Further work could examine how physicians define errors as well as the reliability of error self-report. In addition, to improve the comparability of outcomes, future studies could incorporate and report severity of medical error scores.

There was a diverse set of measures used in the studies that focused on patient satisfaction and quality of care. They varied in what and how they measured the outcome. For example, perceived quality of care was assessed using a variety of measures that ranged from two items for which the psychometric properties were not tested to a scale designed to assess service quality on six dimensions. Thus, it is difficult to discern the extent to which the study results could be attributed to the differences in the dimensions assessed. Further exploration along this line of inquiry could be undertaken to understand the aspects of satisfaction and perceived quality of care that are significantly associated with burnout.

An additional limitation of the existing body of literature is the reliance on cross-sectional study designs. Cross-sectional design limits conclusions regarding causality. Cross-sectional data does not distinguish the sequence of conditions. For example, did burnout cause decreased quality of care? Or, did decreased quality of care cause burnout? At best, the cross-sectional data used in these studies can only be used to determine that there is a relationship. At that same time, there is evidence from studies that have used longitudinal data to examine burnout and medical errors among residents that there is a causal relationship such that burnout causes errors.[53] However, the longitudinal data that contributes to strength of West et al.'s is potentially weakened by the self-reported medical errors.

Finally, only one study[5] described the population from which the study sample was drawn. Thus, it is difficult to determine whether there was a difference between the study participants and non-participants. To aid in the interpretation of the results (i.e., the generalizability), it would be useful for future studies to report this type of information.

Strengths and Limitations of the Search Strategy

Although five databases were used in the search, articles that did not appear in any of the databases would have been missed. To decrease the possibility of this occurring, we employed a broad scope in development of the search terms for each database and followed this with a hand search of included articles. Another potential limitation is the fact that the search focused on articles published in English-language journals. However, despite the English-language constraint, the identified studies originated in European, Middle Eastern, North American and Asian countries. This indicates that although the research was not conducted in countries where English is the first language, at least some of these researchers publish in English-language journals. Finally, there is also a potential limitation associated with focusing on published peer-reviewed articles. In doing so, we may be subject to publication bias.[54] At the same time, the quality of the gray literature has been question because it is not necessarily subject to critical assessment prior to being published.[55] As a result, unpublished studies may be of lower quality and have greater risk of bias in their study designs.

CONCLUSIONS

The focus on quality related to direct care can highlight additional ways that physician burnout affects the healthcare system. These results contribute evidence about whether the effects of physician burnout are limited to physicians or whether consequences of physician

burnout are more extensive. They also can help to inform decisions about how to improve patient care by addressing physician burnout.

The results of this systematic literature review suggest that there is moderate evidence that burnout is associated with safety-related quality of care. Because of the variability in the way patient acceptability-related quality of care was measured and the inconsistency in study findings, the evidence supporting the relationship between burnout and patient acceptability-related quality of care is less strong. Future research evaluating burnout interventions for physicians could consider looking at safety-related quality of care to assess the effectiveness of these interventions. Continued work looking at the relationship between dimensions of acceptability-related quality of measures and burnout is warranted.

DATA SHARING STATEMENT

All the published papers used in this manuscript are publicly available. There are no data available.

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COMPETING INTERESTS

The authors declare that they have no competing interests.

CONTRIBUTORSHIP STATEMENT

CSD led the conception, design, data acquisition, analysis and interpretation of the data; she also led the writing of the overall manuscript. DL collaborated on the design, data acquisition and analysis; he contributed to the writing of the overall manuscript and led the writing of the Methods section. SB collaborated on the design and data acquisition and contributed to the

writing of the manuscript. LT collaborated on the data acquisition and analysis. All authors read and approved the final manuscript. All authors are guarantors of the final manuscript.

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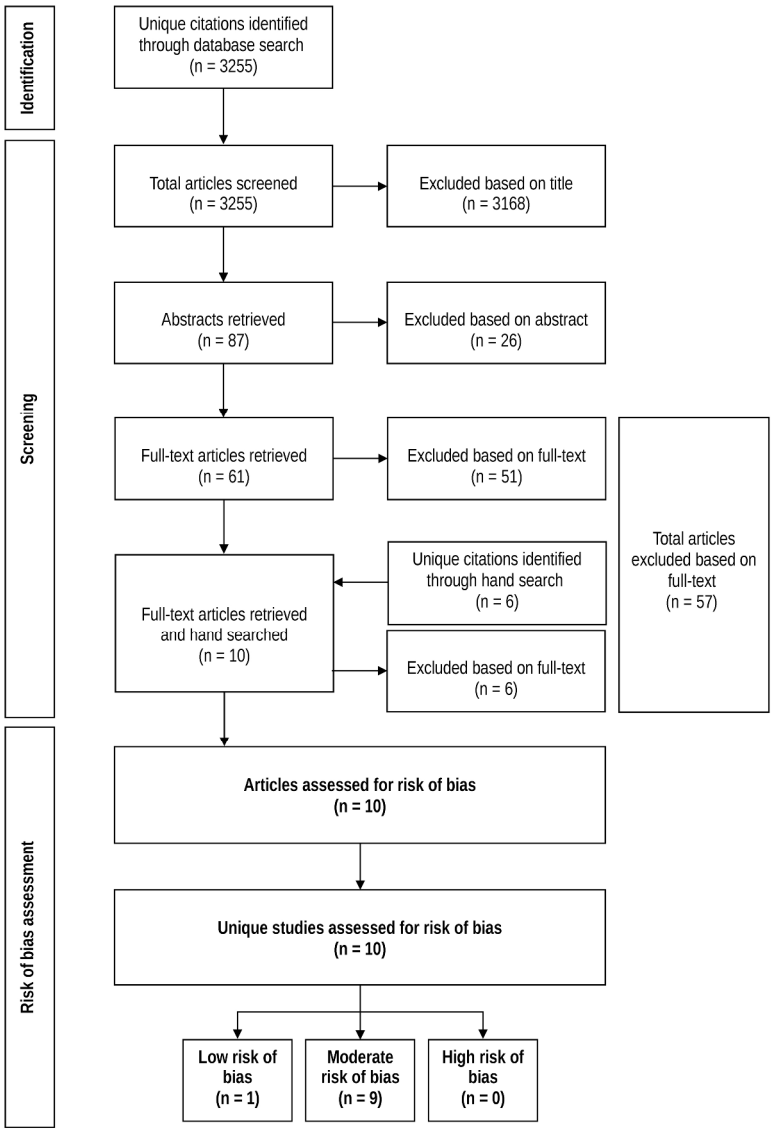

Figure 1. Flowchart of literature search results and the selection process of accepted/rejected articles

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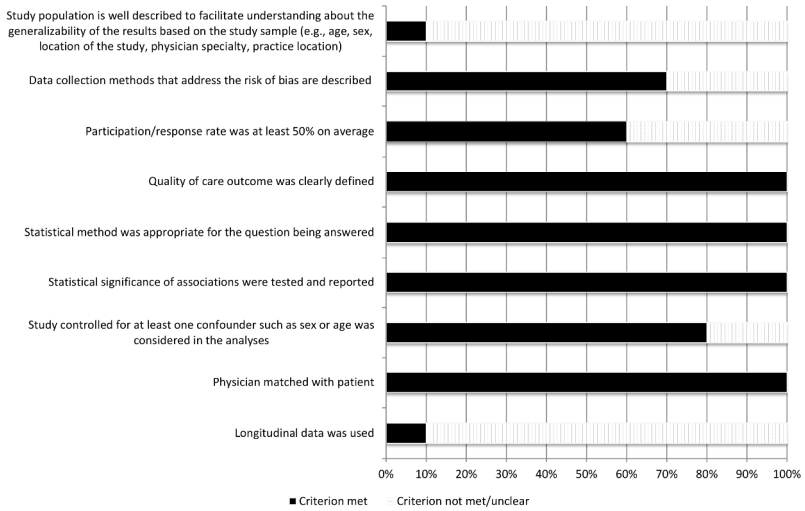

Figure 2. Summary of risk of bias assessment results for across accepted studies

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The Relationship between Physician Burnout and Quality of Healthcare in terms of Safety and Acceptability – A Systematic Review

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The Relationship between Physician Burnout and Quality of Healthcare in terms of Safety and Acceptability – A Systematic Review

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The Relationship between Physician Burnout and Quality of Healthcare in terms of Safety and Acceptability – A Systematic Review

Abstract

Objectives. This study reviews the current state of the published peer-reviewed literature related to physician burnout and two quality of care dimensions. The purpose of this systematic literature review is to address the question, "How does physician burnout affect the quality of healthcare related to the dimensions of acceptability and safety?"

Design. Using a multi-phase screening process, this systematic literature review is based on publically available peer-reviewed studies published between 2002-2017. Six electronic databases were searched: (1) *Medline Current*, (2) *Medline In-process*, (3) *Medline Epub Ahead of Print*, (4) *PsycINFO*, (5) *Embase*, and (6) *Web of Science*.

Setting. Physicians practicing in civilian settings.

Participants. Practicing physicians who have completed training.

Primary and secondary outcome measures. Quality of healthcare related to acceptability (i.e., patient satisfaction, physician communication, physician attitudes) and safety (i.e., minimizing risks or harm to patients)

Results. 4,114 unique citations were identified. Of these, 12 articles were included in the review. Two studies were rated as having high risk of bias and 10 as having moderate risk. Four studies were conducted in North America; four in Europe, one in the Middle East, and three in East Asia. Results of this systematic literature review suggest there is moderate evidence that burnout is associated with safety-related quality of care. Because of the variability in the way patient acceptability-related quality of care was measured and the inconsistency in study findings, the evidence supporting the relationship between burnout and patient acceptability-related quality of care is less strong.

Conclusions. The focus on direct care-related quality highlights additional ways that physician burnout affects the healthcare system. These studies can help to inform decisions about how to improve patient care by addressing physician burnout. Continued work looking at the relationship between dimensions of acceptability-related quality of care measures and burnout is needed to advance the field.

ARTICLE SUMMARY

STRENGTHS AND LIMITATIONS OF THIS STUDY:

- Few studies have examined the current state of knowledge about the relationship between physician burnout and the patient safety and acceptability dimensions of quality of care.

- This systematic literature review employed a broad search of six electronic databases: (1) *Medline Current*, (2) *Medline In-process*, (3) *Medline Epub Ahead of Print*, (4) *PsycINFO*, (5) *Embase*, and (6) *Web of Science*. A manual search was also conducted. In total, 4,114 unique citations were identified and reviewed by three reviewers in pairs.

- We used a comprehensive search strategy that follows the recommended best practices of incorporating adjacency commands and synonyms for keywords.

- One of the limitations of the search strategy employed in this systematic review is its focus on English-language publications.

- Another potential limitation of the search strategy is the focus on published peer-reviewed articles. In doing so, our results may be subject to publication bias.

The Relationship between Physician Burnout and Quality of Healthcare in terms of Safety and Acceptability – A Systematic Review

Reports from around the world indicate that about one-third to one-half of physicians experience at least one dimension of burnout.[1-5] Burnout has been conceptualized as a syndrome consisting of three dimensions: emotional exhaustion (EE), depersonalization (DP) and low personal accomplishment (PA).[6] Maslach et al.[7] define EE as referring to "feelings of being overextended and depleted of one's emotional and physical resources." DP is also referred to as cynicism and defined as "a negative, callous, or excessively detached response to various aspects".[7] PA is also referred to as professional efficacy and "it refers to feelings of incompetence and a lack of achievement and productivity at work".[7] Burnout has been observed to affect personal well-being through low job satisfaction[8-10] and decreased mental health.[11]

Because physicians play an integral role in the healthcare system, the effects of physician burnout are not limited to the physicians experiencing it. Rather, physician burnout potentially impacts the entire healthcare system. For example, a recent systematic literature review reported a negative relationship between burnout and productivity (i.e., early retirement, work cutback, and quitting).[12] The impact of productivity loss related to burnout could lead to fewer available healthcare resources that in turn, can result in healthcare service waitlists. One estimate of the costs of physician work cutback and early retirement related to burnout suggests it totals to at least CAD $213 million in patient services losses.[8]

This raises another question about physicians who continue to practice despite experiencing burnout. Does burnout affect their practice? There is evidence that physician burnout is also related to decreased quality of patient care.[5] The World Health Organization (WHO)[13] and the Institute of Medicine (IOM)[14] suggest that there are six dimensions for quality of healthcare: effectiveness, efficiency, accessibility, equitability, acceptability, and safety.

The purpose of this systematic literature review is to address the question, "How does physician burnout affect the quality of healthcare related to the dimensions of acceptability and safety?" In this review, we focus on two dimensions of quality – acceptability (i.e., patient satisfaction, perceived quality of care, and communication) and safety (i.e., minimizing risks or harm to patients). We choose these two dimensions because they reflect the quality of patient-physician interactions.[15] That is, if a clinician's wellbeing is compromised, their patient interactions may also be negatively affected.[16] In contrast, effectiveness, efficiency, accessibility, equitability reflect the systems (i.e., infrastructure, information technology, payment policies) in which practice is conducted.[14]

Background

There has been growing interest in the relationship between healthcare professional wellbeing and quality of patient care. Although the WHO[13] and IOM[14] identify six dimensions of quality of healthcare, attention has focused on the dimension of patient safety. Recently, there have been four published reviews that focus on the relationship between healthcare professional wellbeing and patient safety.[17-20] For example, Hall et al.[18] consider healthcare staff wellbeing and Salyers et al. [20] examine staff burnout as opposed to specifically examining physician burnout as our review does. de Jong et al.[17] examine common mental disorders as opposed to burnout. Williams and Skinner[19] look at physician satisfaction rather than burnout. Each of these published reviews answer questions that are different from the one addressed in our review. Because they seek to answer different questions, they employ search strategies and inclusion/exclusion criteria that are different from those used in our review. Consequently, they include different articles. For example, Hall et al.'s[18] review does not include nine articles that are in included in our systematic review. Among these, there are six articles related to

acceptability and three articles related to patient safety that were not included in Hall et al.'s[18] review. In comparison to de Jong et al.'s review,[17] our review has six articles on acceptability and five on patient safety that are unique to our systematic review. None of the articles included in our review were included in Williams and Skinner's.[19] Compared to the papers included in Salyers et al.'s[20] review, there are four papers related to physician burnout and safety that are unique to our review and two focused on acceptability that are unique to our review. Thus, our review includes papers that have not been considered together to look at quality of care related to physician interactions with patients and the impact of burnout on physicians.

In addition, none of the published reviews considers the quality of care dimension of acceptability for physicians who have completed training. Yet, along with patient safety, this dimension reflects the quality of interactions between providers and patients. The physician-patient interactions are one of the fundamental interactions in healthcare.[15,19] Furthermore, the IOM[14] asserts that the rise in chronic illnesses necessitates quality interactions to enhance the collaboration between the physician and patient. Quality of physician-patient interactions is reflected in communication, perceived quality of care, and patient satisfaction.[14,15] It is the physician-patient interaction that supports the collaboration that will lead to better patient outcomes.[15]

Wallace et al.[16] assert that physician wellbeing could be used as a quality indicator. The argument could be strengthened by also understanding how wellbeing is associated with the physician-patient interaction-related quality dimensions of safety and acceptability. In particular, burnout could be a focus because it reflects wellbeing and there are standardized measures to identify it. Furthermore, it is a facet of wellbeing that can be influenced by organizational factors and is under the influence of the healthcare system.[16,21,22] Thus, this systematic review of

the literature extends our knowledge about the dimensions of quality of care that reflect physician interactions with patients and a dimension of wellbeing that is affected by the work environment.

METHODS

A systematic review of the literature was reported following the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA) guidelines.[23] Ethics board review was not sought because this review relied solely on publicly available sources of information.

Information Sources

Six databases were searched: (1) *Medline Current* (index of biomedical research and clinical sciences journal articles); (2) *Medline In-Process* (index of biomedical research and clinical sciences journal articles awaiting to be indexed into *Medline Current*); (3) *Medline Epub Ahead of Print* (index of articles that appear on publisher websites in advance of the journal release) (4) *PsycINFO* (an index of journal articles, books, chapters, and dissertations in psychology, social sciences, behavioral sciences, and health sciences); (5) *Embase* (index of biomedical research, and abstracts from biomedical, drug and medical device conferences); and (6) *Web of Science* (index of journal articles, editorially selected books and conference proceedings in life sciences and biomedical research).

Search Strategy

Collaborating with the professional health science librarian (SB) member of this research team, search strategies were developed and tailored for each database following the Peer Review of Electronic Search Strategies (PRESS) guidelines[24] (Supplementary File 1: Search terms used in search strategy). Because recommended guidelines were used for this review's search

strategies, the search strategy that we used is also a contribution to the literature. As this literature grows, the strategy can be used in future searches on the topic. The searches were conducted in February 2017. The OVID platform was used to search *Medline Current*, *Medline In-Process*, *Medline Epub Ahead of Print*, *PsycINFO*, and *Embase*. *Web of Science* was searched using the Thomson Reuters search interface. The search period covered January 2002 – February 2017; all searches were limited to English language journals. The time frame was chosen to represent the current healthcare environments in which physicians are practicing. For example, the year 2002 was the year after the Institute of Medicine's report[14] on the quality of healthcare that discussed the six dimensions of quality of care. By beginning in 2002, we have allowed for a one year lag after publication of this report during which healthcare settings and researchers could have incorporated the Institute of Medicine's quality of healthcare framework into their work.

Our searches sought to identify articles about practicing physicians regardless of specialty working in civilian settings (i.e., non-military settings). In this review, the physician search included: allergists, anesthesiologists, cardiologists, clinical pharmacologists, clinical toxicologists, dermatologists, doctors, endocrinologists, gastroenterologists, gynecologists, hematologists, immunologists, medical biochemists, medical geneticists, medical microbiologists, nephrologists, neurologists, neuropathologists, neuroradiologists, occupational physicians, oncologists, ophthalmologists, pathologists, pediatricians, physicians, psychiatrists, radiologists, rheumatologists, surgeons, and urologists. The search strategy did not seek to exclude residents and medical students. Rather, a broad search strategy was employed to increase the likelihood that all studies on physician burnout would be found. The reference lists of all accepted full-text articles were hand searched.

Screening process

Relevant articles were identified using a multi-phase screening process that involved reviewer pairs using the inclusion and exclusion criteria for this review. In the first step, titles were screened. Next, abstracts of the articles that remained after the first step were screened. The final step of the process involved screening the full text of all articles that passed the first and second phases. In the full text screening, papers for which there was insufficient information in the title and abstract to determine relevancy were also included. Two pairs of reviewers (CSD and LT, CSD and DL) independently completed the multi-phase screening process. The inter-rater reliability corrected for chance[25] between CSD & LT and CSD & DL was $\kappa = 0.96$ and $\kappa = 0.98$, respectively. Before moving onto each stage, disagreements were discussed until consensus was reached.

For this review, burnout was defined as a syndrome of emotional exhaustion, cynicism (depersonalization) and reduced feelings of personal accomplishment related to work.[6] Quality of care related to acceptability was identified with measures reflecting physician-patient interactions such as patient satisfaction, perceived quality of care, physician communication with patients, and physician attitudes towards patients. In addition, safety was identified by measures that reflected risks or harm to patients such as medical errors.

Study inclusion criteria were:

1. Studies reported quality of care outcomes related to acceptability and/or safety
2. The sample population was comprised of practicing physicians regardless of specialty who worked in civilian settings. That is, the results were reported such that the practicing physician (as opposed to resident) outcomes were reported separately.
3. Burnout was assessed based on a psychometrically validated measure
4. Paper reports original research

Exclusion criteria were:

1. The study sample was comprised only of residents and medical students
2. The study did not examine the relationship between burnout and one of the two quality of care dimensions
3. Burnout was not assessed based on a validated measure
4. The paper was a review article or commentary

Risk of Bias Assessment

All included articles were assessed for risk of bias by both pairs of reviewers (CSD & LT, and CSD & DL). Disagreements between the pairs of reviewers were discussed until consensus was reached.

To assess the risk of bias in observational studies, Sanderson et al.[26] recommend the use of a transparent checklist that concentrates on the "few, principal, and potential sources of bias in a study's findings". They assert that the fundamental domains should include: (1) the appropriate selection of participants, (2) appropriate measurement of variables, and (3) appropriate control of confounding. In accordance with their recommendations and the Strengthening of Observational Studies in Epidemiology (STROBE) criteria,[27] a 9-item risk of bias checklist with the following criteria adapted from Lagerveld et al.[28] was used:

1. Study population is well described to facilitate understanding about the generalizability of the results based on the study sample (e.g., age, sex, location of the study, physician specialty, practice location)
2. Data collection methods that address the risk of bias are described
3. Participation/response rate was at least 50% on average
4. The psychometric properties of the quality of care outcome measure have been tested
5. Statistical method was appropriate for the question being answered
6. Statistical significance of associations were tested and reported
7. Study controlled for at least one confounder such as sex or age in the analyses

8. Physician matched with patient
9. Longitudinal data was used

Each item was scored "1" if the criterion had been met. Each article could achieve a maximum score of 9. Based on their total score, articles were categorized either as low (8-9 points), moderate (5-7 points), or high risk of bias (1-4 points).

RESULTS

Article Inclusion and Exclusion Results

The electronic literature search resulted in the identification of 4,114 unique citations (Figure 1). Based on the title review, 4,020 citations were excluded; this left 94 articles for abstract review. During the abstract review, another 28 citations were excluded; this left 66 articles for full-text review. Reasons for article exclusions at full text review were: (1) not a relevant outcome (n = 10), (2) sample not comprised of physicians/cannot distinguish physicians as a group from other clinicians (n = 15), (3) it was not original research (n = 20), (4) burnout not measured with a validated instrument (n = 1), and (5) not published in a peer-reviewed journal (n = 8). After the full-text review, 12 articles remained and their reference lists were hand searched for relevant studies. The hand search identified six additional citations; all six were excluded at full-text review.

Insert Figure 1

Risk of Bias Assessment Results

Our assessment indicated 10 of the 12 studies were of moderate risk of bias; two were of high risk of bias. Figure 2 illustrates the limitations of these studies. Two studies comprehensively[5,29] described the study population from which the study sample was drawn.

Two studies used longitudinal data.[29,30] Other limitations involved not reporting the response rate[31-34] and not controlling for possible confounding factors in the statistical analyses.[34,35] There was also variability in the use of validated outcome measures; only three studies used validated instruments to measure their outcomes. [31,33,35] All included studies employed appropriate statistical tests. All but one[29] reported the results of the statistical testing (Supplementary File 2: Risk of Bias Assessment Checklist).

Insert Figure 2

Overview of the Studies

Of the 12 studies that met the inclusion criteria (Table 1), four were conducted in the US, two in Germany, one each in Greece, Israel, Japan, China, and Taiwan. There was one multi-national study based on data from Italy, Spain, and Portugal.

Table 1. Description of the Studies

Author(s)	Study Population	Description of Sample	Burnout Measure	Quality of Care Measure
Anagnostopoulos et al. (2012)[31] Greece	Physicians working in three large primary health care centers. Patients of participating physicians. Patients selected through systematic random sampling – 1:3 consecutive patients. Physician response rate: 85.8% Patient response rate: Not reported	n = 30 physicians ≤ 10 years practicing: 53% Specialties: General practitioners: 63% Pathologists/internists: 23.3% Male: n = 17 Female: n = 13 > 50 yrs: 43% 26-50 yrs: 40% n = 300 patients Male: 46% Female: 54% Mean age: 54 ± 15 yrs	Greek translation of the 22-item Maslach Burnout Inventory-Human Services Survey	Patient report: Patient satisfaction assessed using 18-item Consultation Satisfaction Questionnaire.[36] 5-point Likert scale from 1 = "strongly agree" to 5 = "strongly disagree". Satisfaction sub-scales: (1) General, (2) Perceived length of consultation, (3) Depth of relationship, (4) Professional care provided Overall satisfaction: sum of all items (max score = 90) Scale was translated into Greek using back-translation and pilot testing. English version's psychometric properties tested.[36,37]
Halbesleben and Rathert (2008)[32] USA	Attending physicians of university students who had been hospitalized in past year. Student response rate: Not reported	n = 178 physicians Yrs practicing: Not reported Specialties: Not reported Male: n = 84 Female: n = 94 Mean age = 46 ± 13 yrs n = 178 patients Male: n = 98 Female: n = 80 Mean age: 23 ± 5 yrs	22-item Maslach Burnout Inventory-Human Services Survey modified to apply to patients rather than general care recipients	Patient report: Patient satisfaction assessed using 22-item SERVQUAL.[38] 7-point Likert scale from 1 = "strongly disagree" to 7 = "strong agree". Psychometric properties tested but subsequent study suggested need for further exploration regarding its validity.[39]
Hayashino et al. (2012)[30] Japan	Members of a panel of 6,459 hospital-based physicians recruited through hospital lists and scientific meetings. A randomly selected sub-sample of 1,198 were invited to participate. Response rate: 70%	n = 836 physicians Yrs practicing: Not reported Male: 92% Female: 8% 28-39 yrs: 23% 40-49 yrs: 47% 50-59 yrs: 26% 60-81 yrs: 4%	17-item Maslach Burnout Inventory developed for Japanese healthcare professionals based on the MBI-Human Services Survey Used burnout thresholds: EE: ≥ 21 DP: ≥ 18 PA: ≤ 16	Physician report: Perceived medical errors assessed with questions: "Are you concerned that you have made any major medical mistakes in the last year?" IF "yes", asked about number of medical errors that concerned respondent. Psychometric properties not tested.

Author(s)	Study Population	Description of Sample	Burnout Measure	Quality of Care Measure
Klein et al. (2010)[5] Germany	Physicians in surgery working in > 100 beds general hospitals with a general surgical and/or gynecological ward. Stratified probability sample based on hospital beds. Response rates: Hospital level: 53% Physician level: 36% Physicians in participating hospitals: 65%	n = 1,311 physicians Mean yrs practicing: 11 yrs Male: 60% Female: 40% Mean age = 45 ± 8.5 yrs	Copenhagen Burnout Inventory (CBI). Three scales assessing personal, client, and work burnout. This study focused on personal burnout (i.e., degree of physical and psychological fatigue and exhaustion).	Physician report: Perceived quality of care assessed using short version of Chirurgisches Qualitässiegel. Created three sub-scales: (1) psychosocial care, (2) diagnosis/therapy, (3) quality assurance. 5-point Likert scale from 1 = "very good" to 5 = "bad". Two questions about frequency of diagnostic and therapeutic errors: "I have made mistakes in diagnosis." and "I have made mistakes in treatment." 4-point Likert scale ("never" to "often"). Psychometric properties not tested for either set of questions.
Rabatin et al. (2016)[29] USA	Primary care physicians in New York City, Chicago, and rural and urban Wisconsin Recruited 1-6 patients/physician with diabetes, hypertension or congestive heart failure Response rate: Physicians: 59.6% Nonparticipants did not differ from participants in specialty, age, or sex	n = 119 practices n = 449 physicians n = 1,419 patient charts Physician characteristics: Male: n = 235 Female: n = 187 Mean age: 43 ± 10yrs Specialties: Family Medicine: 47% General Internal Medicine: 50% Patient characteristics: Not reported	Single item measure: "Using your own definition of burnout… (a) I have no symptoms of burnout; (b) Occasionally I am under stress… but I don't feel burned out; (c) I am definitely burning out and have one or more symptoms of burnout, such as physical and emotional exhaustion; (d) The symptoms of burnout that I'm experiencing won't go away…; (e) I feel completely burned out and often wonder if I can go on…" The question correlates with the Emotional Exhaustion dimension of Maslach Burnout Inventory.[40]	Patient chart: Chart audit using a standardized template to retrospectively assess over 18-months for guideline adherence, responsiveness to "recurrent abnormalities" and missed drug interactions. Reliability not reported.

Author(s)	Study Population	Description of Sample	Burnout Measure	Quality of Care Measure
Ratanawongsa et al. (2008)[33] USA	Physicians from 15 urban community-based clinics who provided primary care to adult patient enrolled in a randomized controlled trial for hypertensize minority patients. Response rate: Not reported	n = 40 physicians Mean years of practice: 11 ± 7.7 yrs Male: 47% Female: 53% Mean age: 42 ± 8.7 yrs Specialties: Internal Medicine: 83% Family Practice: 15% General Practice: 2% n = 235 patients Male: 34% Female: 66% Mean age: 59 ± 13.2 yrs	A 6-item scale derived from the Maslach Burnout Inventory that captures the domains of EE and PA. Five point Likert scale from 1 = "strongly agree" to 3 = "neutral" to 5 = "strongly agree". Based on terciles, burnout scores were categorized as low, average, high.	Physician report: Physicians completed "brief questionnaires indicating the degree to which they knew the patient, their attitudes toward the patient in general, and their attitudes regarding the visit". Audiotaped encounters analyzed for rapport-building communication behaviors using the Roter Interaction Analysis System. Four types of rapport identified: (1) Positive, (2) Negative, (3) Emotional, (4) Social Reliability and predictive validity tested.[41]
Shanafelt et al. (2010)[42] USA	American surgeons who were members of the American College of Surgeons who permitted email correspondence. Response rate: 32%	n = 7,905 physicians Specialties: General: 41% Cardiothoracic: 6% Colorectal: 4% Otolaryngology: 5% Obstetrics/gynecology: 1% Oncologic: 5% Pediatric: 2% Plastic: 4% Transplant: 2% Trauma: 4% Urologic: 4% Vascular: 6% Other: 6% Male: 87% Female: 13% Median age (IQR): 51 yrs (43, 59)	22-item Maslach Burnout Inventory-Human Services Survey	Physician report: Response to: "Are you concerned you have made any major medical error in the last 3 months?" Psychometric properties not tested.
Shirom et al. (2006)[43] Israel	Physicians from 4 health plans specializing in either: ophthalmology, dermatology, otolaryngology, gynecology (community-based), general surgery, cardiology (hospital-based). 50% random probability sample drawn from each specialty. Response rate: 63%	n = 890 physicians Male: 80% Female: 20% Median age: 52 yrs	12-items from the Shirom-Melamed Burnout Measure with 3 sub-scales: (1) physical fatigue, (2) cognitive weariness, (3) emotional exhaustion	Physician report: Physicians completed a 15-item version of the modified SERVQUAL. 5-point Likert scale from 1 = "to a very small extent" to 5 = "to a very large extent". Psychometric properties of the modified version not tested.

Author(s)	Study Population	Description of Sample	Burnout Measure	Quality of Care Measure
Travado et al. (2005)[34] Italy, Spain, Portugal	Physicians recruited from cancer centers of three hospitals – two general hospitals with a cancer ward and one cancer hospital. Convenience sample Response rate: Not reported	n = 125 physicians Yrs of practice: 15 ± 9.4 yrs Male: 47% Female: 54% Mean age: 42 ± 9.7 yrs	22-item Maslach Burnout Inventory-Human Services Survey Used Maslach and Jackson[6] cutoff scores for no/low burnout, intermediate, and high burnout.	Physician report: Communication skills assessed using two scales: (1) Self-Confidence in Communications Skills (SCSS). 12-item scale rating ability to communicate and manage a series of clinical situations. (2) Expected Outcomes of Communication (EOC). 23-item scale assessing extent to which physician perceives result of communication is positive or negative. Psychometric testing not completed.[44]
Weigl et al. (2015)[45] Germany	Physicians working in one academic children's hospital who were providing patient care. Response rate: 74%	n = 88 physicians Yrs of practice: 8 ± 6.7 yrs Male: 47% Female: 53% Mean age: 37 ± 8.6 yrs	Two sub-scales of the German version of the Maslach Burnout Inventory-D: Emotional Exhaustion and Depersonalization. High burnout defined as Mean EE score > 3.5 and Mean DP > 2.5	Physician report: 2-item perceived quality of care measure: "My workload frequently leads to reduced quality of work" and "Adverse work conditions frequently lead to a loss of quality." 5-point Likert scale from 1 = "not at all" to 5 = "a very great extent". Psychometric properties not tested for the two items taken from the German version of the MBI.
Wen et al. (2016)[46] China	Physicians practicing in one of 46 hospitals in 10 provinces n = 12 tertiary hospitals n = 9 secondary hospitals n = 25 primary hospitals In the secondary and tertiary hospitals, physicians were selected from ≥ 10 clinical departments with ≥ 10 people in the age groups: < 30 yrs, 30-39 yrs, 40-49 yrs, ≥ 50 yrs Response rate: 89%	n = 1,607 total physicians n = 192 physicians from primary hospitals n = 354 physicians from secondary hospitals n = 991 physicians from tertiary hospitals Primary hospital Male: 54% Female: 46% Mean age: 37 ± 9.9 yrs Education: ≤ high school: 17% Some college: 47% Bachelors' degree: 35% ≥ Master's degree: 1.0% Secondary hospital	Used 15-item Chinese version of the Maslach Burnout Inventory-General Survey Respondents grouped into three categories: (1) No burnout symptoms (2) Some burnout symptoms (3) Serious burnout symptoms	Physician report: Physicians were asked if they had made any of the following medical errors: (1) patient was harmed, (2) medication error, (3) treatment delayed, (4) incomplete or incorrect item in the patient record. Psychometric properties not tested.

Author(s)	Study Population	Description of Sample	Burnout Measure	Quality of Care Measure
		Male: 53% Female: 47% Mean age: 36 ± 9.4 yrs Education: ≤ high school: 4% Some college: 17% Bachelors' degree: 73% ≥ Master's degree: 6% Tertiary hospital Male: 61% Female: 39% Mean age: 36 ± 8.0 yrs Education: ≤ high school: 1% Some college: 3% Bachelors' degree: 46% ≥ Master's degree: 51%		
Weng et al. (2011)[35] Taiwan	Physicians working in two hospitals. Patients of participating physicians. Physician response rate: Not reported Patient response rate: 78%	n = 110 internists Male: 85% Female: 15% Mean age: 41 ± 6.9 yrs n = 2,872 patients Male: 59% Female: 41%	Maslach Burnout Inventory-Human Services Survey	Patient report: Patient satisfaction assessed with two questions: "I am satisfied with the care provided by my doctor" and "I would recommend this doctor to my friends and family members". Single item from the CSQ's[36] General Satisfaction sub-scale not validated for individual use. Single item about recommendation was correlated with EUROPEP patient satisfaction questionnaire.[47]

Description of the Study Populations

Six of the studies focused on hospital-based physicians.[5,30,34,35,45,46] Among these studies, two focused on cancer[34] and children's[45] specialty hospitals. In addition, one of these studies recruited surgeons practicing either in general surgery or gynecological wards.[5] One of these studies[46] also included people practicing as physicians who did not have graduate educations.

The remaining five studies recruited physicians practicing in a variety of settings. Three studies sought physicians in primary health care centers;[29,31,33] they included physicians practicing in internal medicine, general practice, and family practice. One of the studies[29] that recruited primary care physicians focused on the quality of care only for patients with diabetes and/or hypertension.

Two studies did not specify the setting.[32,42] However, of these two, one focused on surgeons.[42] Finally, one study used four health plans to recruit and contained a mixture of community and hospital physicians[43] which included physicians specializing in ophthalmology, dermatology, otolaryngology, community-based gynecology, general surgery, and hospital-based cardiology.

Measuring Burnout

In nine of the 12 studies, burnout was measured using either the 22-item Maslach Burnout Inventory (MBI),[6] translated version of the MBI-GS,[46] translated version of the MBI-HS[30,31] or selected MBI sub-scales.[30-35,42,45,46] The complete 22-item MBI measures three dimensions of burnout: Emotional Exhaustion, Depersonalization and Personal Accomplishment. It is one of the most widely used measures of burnout in the scientific literature.[48,49] One study[29] used a single item measure for burnout that correlates with the Emotional Exhaustion sub-scale of the MBI.[40]

The two remaining studies used the Copenhagen Burnout Inventory (CBI)[48] and the Shirom-Melamed Burnout Measure (SMBM).[49,50] The CBI is a 19-item scale comprised of three sub-scales that assess personal burnout, work-related burnout, and client-related burnout.[48] It has been shown to be correlated with mental and general health as well as job satisfaction.[48] The SMBM is a 22-item measure with three sub-scales that assess physical fatigue, emotional

exhaustion, and cognitive weariness.[49] The psychometric properties of these scales continue to be explored.[49,51,52]

Measuring Quality of Care related to Acceptability and Patient Safety

Four types of quality of care measures related to acceptability and safety were used in these studies. In terms of patient safety, medical errors were measured. Acceptability related measures included patient satisfaction, perceived general quality of care, and physician communication/attitudes.

Patient Safety Measures: Medical errors

Patient safety was examined with medical errors. This outcome was assessed in five studies.[5,29,30,42,46] Wen et al.[46] asked respondents whether they had made any medical errors including one that resulted in a patient being harmed, a medication error, delay in treatment, or incomplete or incorrect item being added to the patient record. Hayashino et al.[30] and Shanafelt et al.[42] used similar questions about whether the respondent made major medical errors. However, the studies differed in the time frame that the respondent was asked to consider. Hayashino et al.[30] asked about the past year while Shanafelt et al.[42] inquired about the past three months. In contrast to these studies, Klein et al.[5] asked about frequency of diagnostic mistakes and treatment without specifying a time frame. The studies differ in the types of errors that they asked about (i.e., *major* errors rather than *any* errors). In addition, they depend on recall and self-report. Shanafelt et al.[42] note that studies have used this type of question to gather information about medical errors. However, there are also studies that have found that physicians under-report medical errors.[53] Furthermore, there is evidence that physicians have a limited ability to self-assess their practice patterns.[54]

In addition to questions about frequency of diagnostic mistakes and treatment, Klein et

al.[5] included a questionnaire based on the Canadian Physician Achievement Review to evaluate physician self-perceived quality of psychosocial care, diagnosis/therapy, and quality assurance.[55] However, the authors note that additional work regarding its validity is warranted.[5]

There was only one study that did not rely on self-report to gather information about medical errors. Rabatin et al.[29] used a chart audit to assess medical errors characterized by adherence to guidelines, responsiveness to "recurrent abnormalities" and missed drug interactions.

Acceptability Measures: Patient satisfaction/Perceived Quality of Care

With regard to acceptability measures, patient satisfaction was assessed in four studies.[31,32,35,43] In two of these studies, the SERVQUAL was used to measure patient satisfaction/quality of care.[32,43] The SERVQUAL was developed to measure service quality along five dimensions: (1) tangibles (i.e., physical facilities), (2) reliability (i.e., performs dependably and accurately), (3) responsiveness (i.e., willingness to help), (4) assurance (i.e., ability to inspire trust), and (5) empathy (i.e., caring).[56] Halbesleben and Rathert[32] used a healthcare specific version of the SERVQUAL. The psychometric properties of the scale were examined.[38] However, Asubonteng et al.[39] have raised questions about the strength of the scale's psychometric properties.

Shirom and colleagues[43] adapted the SERVQUAL by eliminating seven items and revising the language for physicians to rate their own quality of care using the remaining 15 items. The validity of this modified measure was not examined.

Weigl et al.[45] looked at physician-perceived quality of care by asking physicians to rate two statements on a 5-point scale, "My workload frequently leads to reduced quality of work," and "Adverse work conditions frequently lead to a loss of quality." The authors reference the

German version of the MBI as the source for these questions. However, they do not provide information about the psychometric properties of the individual use of these items.

One study[31] used the Consultation Satisfaction Questionnaire (CSQ) scale that was created and validated to assess patient satisfaction with general practitioners.[36] It is comprised of 18 items and measures satisfaction along four dimensions: general satisfaction, professional care, depth of relationship, and perceived time.

Finally, in their study, Weng et al.[35] used two questions to indicate patient satisfaction, "I am satisfied with the care provided by my doctor," and "I would recommend this doctor to my friends and family." The first of Weng et al.'s[35] question is similar to one of the CSQ's[36] general satisfaction items, "I am totally satisfied with my visit to the doctor." However, the use of this single-item has not been validated. A version of the second question has been used to measure satisfaction and was correlated with the EUROPEP patient satisfaction questionnaire.[47]

Acceptability Measures: Communication/Attitudes

Two studies focused on physician communication/attitudes.[33,34] Using audiotapes of physician/patient interactions, Ratanawongsa et al.[33] assessed the interactions by employing the Roter Interaction Analysis System (RIAS).[57] RIAS is a validated method of categorizing these interactions into three categories related either to content, affection, or process.[58] There is evidence that there is an association between the content and the socioemotional nature of the interactions as categorized using the RIAS and patient satisfaction.[57,58]

Travado et al.[34] examined the association between burnout and communication using two measures: the Self-Confidence in Communications Skills (SCSS) and the Expected Outcomes of Communication (EOC).[44] In their article, Parle and colleagues[44] note that exploration of the psychometric properties of both measures were being conducted but were not yet completed.

Both were developed to understand the communication skills of physicians working with cancer patients.

Study Outcomes: Burnout and Quality of Care

In this sub-section, we report about the quality of care outcomes from the included studies (Table 2). This review of outcomes begins by describing the findings regarding the association between burnout and patient safety (i.e., medical errors). It is followed by reporting of the acceptability outcomes as measured by patient satisfaction/perceived quality of care and physician communication/attitudes.

Outcomes: Burnout and Medical Errors

Table 2 contains the outcomes reported by the included papers. In terms of findings for the association between burnout and medical errors, there was a consistently significant relationship between burnout and medical errors among four papers focusing on this relationship.[5,30,42,46] Shanafelt et al.[42] reported significantly higher odds of a major medical error during the past three months among physicians with higher EE and DP but lower odds among physicians with higher PA. Hayashino et al.[30] also observed significant associations between a major medical error during the past 12 months and higher levels of EE and DP; however, the relationship with PA was not significant. Klein et al.[5] reported significant associations between high burnout and diagnostic error, therapeutic error, sub-optimal psychosocial care, sub-optimal diagnosis and treatment, and sub-optimal quality assurance. Wen et al.[46] found higher odds of medical errors among physicians with either some or serious burnout symptoms as opposed to no burnout symptoms.

The one paper[29] that assessed errors based on chart audits did not find a significant relationship between burnout and medical errors. But, it should be noted that this study focused

on treatment for a sub-group of patients with chronic disorders that included diabetes and/or hypertension.

Table 2. Patient Safety and Acceptability Related Quality of Care Outcomes

Author(s)	Medical Errors (ME)	Patient Satisfaction (PS)/Quality of Care (QoC)	Communication/Attitudes
Anagnostopoulos et al. (2012)[31] Greece		Correlation btwn Maslach Burnout Inventory (MBI) dimensions and PS: • EE & PS: r = -0.64, p<0.01 • DP & PS: r = -0.54, p<0.01 • PA & PS: r = 0.26, p=0.17 Results of mixed effect model with PS as outcome: • Low EE associated with highest average PS Comparison btwn moderate and high EE no significant difference in association with PS	
Halbesleben and Rathert (2008)[32] USA		Correlation btwn MBI dimensions and PS: DP & PS: r = -0.16, p<0.05	
Hayashino et al. (2012)[30] Japan	Association btwn MBI dimensions and any medical error: • Significant differences among tertiles for EE (p= 0.026) & DP (p=0.002) % with ME by burnout dimension tertile: EE 1st tertile: 27.9% EE 2nd tertile: 38.2% EE 3rd tertile: 33.9% DP 1st tertile: 35.0% DP 2nd tertile: 27.8% DP 3rd tertile: 37.2% • No significant differences among tertiles for PA (p=0.67)		
Klein et al. (2010)[5] Germany	Adjusted* Odds Ratios (95% CI) for probability of error and high burnout score: • Diagnostic error: 1.66 (1.26, 2.20) • Therapeutic error: 1.94 (1.39, 2.69) *Adjusted for gender, occupational position, job experience	Adjusted* Odds Ratios (95% CI) for probability of suboptimal care and high burnout score: • Psychosocial care = 1.58 (1.19, 2.10) • Dx/Tx = 1.59 (1.17, 2.16) • Quality assurance = 1.45 (1.10, 1.90) *Adjusted for gender, occupational position, job experience	
Rabatin et al. (2016)[29] USA	Statistics not reported No statistically significant differences between physicians with burnout and without.		

Author(s)	Medical Errors (ME)	Patient Satisfaction (PS)/Quality of Care (QoC)	Communication/Attitudes
Ratanawongsa et al. (2008)[33] USA		Adjusted* Odds Ratios (95% CI) for probability of PS with high vs low burnout: • PS = 0.44 (0.18, 1.08), p=0.07 *Adjusted for patient health insurance, visit length, physician gender, physician IMG status, interaction btwn IMG status and burnout	Odds Ratios (95% CI) for probability of negative rapport building with medium and high vs low burnout: • Medium: 1.85 (1.31, 2.61), p=0.001 • High: 2.06 (1.58, 2.86), p<0.001 *Adjusted for patient health insurance, visit length, physician gender, physician IMG status, interaction btwn IMG status and burnout
Shanafelt et al. (2010)[42] USA	Odds Ratios (95% CI) for perceived medical error with MBI dimensions: • EE = 1.048 (1.042, 1.055), p<0.0001 • DP = 1.109 (1.096, 1.122), p<0.0001 • PA = 0.965 (0.955, 0.975), p<0.0001		
Shirom et al. (2006)[43] Israel		Structural equation model examining relationships of autonomy, burnout and QoC: • Relationship btwn global burnout and QoC not significant (β = -0.12, p>0.05) • EE exhaustion negatively related to QoC (β = -40, p<0.05)	
Travado et al. (2005)[34] Italy, Spain, Portugal			Correlations btwn MBI burnout dimensions and communication: Self-Confidence in Communication Skills • EE: r = -0.03, not significant • DP: r = -0.08, not significant • PA: r = 0.37, p<0.01 Negative Expected Outcomes of Communication • EE: r = -0.21, p<0.05 • DP: r = -0.25, p<0.01 • PA: r = 0.28, p<0.01 Positive Expected Outcomes of Communication • EE: r = 0.01, not significant • DP: r = 0.34, p<0.01 • PA: r = -0.28, p<0.01
Weigl et al. (2015)[45] Germany		Adjusted* Odds Ratios (95% CI) for probability of low QoC with MBI dimensions (Low vs High): • EE = 0.75 (0.08, 1.42), p<0.05 • DP = 0.17 (-0.45, 0.80), not significant *Adjusted for gender, professional tenure, clinical work environment, career stage/position	

Author(s)	Medical Errors (ME)	Patient Satisfaction (PS)/Quality of Care (QoC)	Communication/Attitudes
Wen et al. (2016)[46] China	Adjusted* Odds Ratios (95% CI) for probability of any medical error with no burnout symptoms group as reference: • Some burnout symptoms: 1.46 (1.13, 1.89) • Serious burnout symptoms: 2.28 (1.63, 3.17) *Adjusted for sex, workload, and hospital type		
Weng et al. (2011)[35] Taiwan		Correlation btwn MBI burnout dimensions and PS: • EE: not significant • DP: negative relationship ($p<0.01$) • PA: not significant	

Outcomes: Burnout and Patient Satisfaction/Quality of Care

Among the four studies that examined the relationship between burnout and patient satisfaction/quality of care, three observed a significant relationship between either burnout or at least one dimension of burnout.[31-33,35] The one study[33] that combined the MBI EE and PA dimensions to create a single burnout score did not find a significant relationship between the score and patient satisfaction. Because it used only two sub-scales and one of them was PA rather than DP, it is not clear regarding the extent to which their choice of sub-scales was consistent with the other measures of burnout.

Among the three studies that reported separate MBI dimensions, there seemed to be a consistent observation that high DP is significantly related to lower patient satisfaction.[31,32,35] However, the significance of the association between EE and patient satisfaction varied among studies; Anagnostopoulos et al.[31] reported a significant correlation but Weng et al.[35] did not.

At the same time, Shirom et al.[43] described a significantly negative relationship between high EE and physician perceived quality of care. Weigl and colleagues[45] also found a significant negative relationship with EE but did not find a significant relationship between DP and physician perceived quality of care.

Outcomes: Burnout and Communication/Attitudes

Travado et al.[34] found a significantly positive relationship between PA and self-confidence in communication skills as well as with negative expected outcomes of communication. They also observed a significantly negative association between PA and positive expected outcomes of communication. In addition, Ratanawongsa et al.[33] reported a higher probability of negative rapport with medium and high burnout.

DISCUSSION

This systematic literature review identified 12 studies of which 10 had a moderate risk of bias and two had a high risk of bias. The results of these physician burnout studies show that patient safety has been primarily measured by examining medical errors. The acceptability outcomes have been captured using two groups of indicators that measure patient satisfaction/perceived quality of care and physician communication/attitudes towards patients. The majority of these studies examined the relationship between burnout and acceptability. Among the acceptability-related quality of care outcomes, the focus has been on patient satisfaction/perceived quality of care.

The results of four of the five included studies that reported on the relationship between burnout and medical errors suggest there is evidence that burnout is associated with physician self-perceived medical errors and sub-optimal care. However, there is equivocal evidence that specific dimensions of burnout are related to the acceptability dimension of quality of care as measured by patient satisfaction, perceived quality of care, or physician communication/attitudes. Thus, the current body of evidence suggests there is moderate evidence for the association between burnout and safety aspects of healthcare whereas the evidence is weaker for the patient-related acceptability aspects of quality.

Strengths and Limitations of Interpreting the Literature

One of the important questions raised by burnout studies in general is highlighted by Klein et al.'s[5] and Shirom et al.'s[43] use of non-MBI scales. Klein and colleagues[5] used the Copenhagen Burnout Inventory while Shirom et al.[43] used the Shirom-Melamed Burnout Measure. One of the criticisms that the separate developers of these two scales raise is that the MBI does not fully assess burnout.[43,48] Rather, both groups argue that fatigue and exhaustion are fundamental to the definition of burnout.[43,48] However, this emphasis on exhaustion may be reflected in the fact that EE is the most widely studied of the MBI dimensions.[59] This would argue for the assessment of this dimension in studies of burnout and the individual reporting of it.

Another limitation of these studies was the reliance on physician self-report data for the assessment of medical errors. The self-report could be influenced by a number of factors including recall bias and social desirability. There is a potential additional bias introduced if self-report is used for both the outcome and the problem.[60] The presence of burnout could also influence perceptions. For example, Fahrenkopf et al.[61] observed a discrepancy between the results of chart audits and physician self-report; those with higher burnout scores reported higher numbers of medical errors than the chart audits would suggest.

An alternative to self-report would be observational data. However, watching physicians while they practice could lead to a Hawthorne Effect. Another alternative would be to review medical records to identify errors. But, this relies on the accuracy of the records. Also, it is not clear what types of medical errors should be assessed – major errors leading to an adverse event or any medical error regardless of outcome? In their study, Fahrenkopf et al.[61] used a standardized method to abstract information from charts and trained reviewers to categorize the

errors into groups: (1) preventable adverse event, (2) non-preventable adverse event, (3) potential adverse event, and (4) error with little potential for harm. Further work could examine how physicians define errors as well as the reliability of error self-report. In addition, to improve the comparability of outcomes, future studies could incorporate and report severity of medical error scores.

There was a diverse set of measures used in the studies that focused on patient satisfaction and quality of care. They varied in what and how they measured the outcome. In addition, the majority of the studies did not use validated outcome measures. For example, perceived quality of care was assessed using a variety of measures that ranged from two items for which the psychometric properties were not tested to a scale designed to assess service quality on six dimensions. Thus, it is difficult to discern the extent to which the study results could be attributed to the differences in the dimensions assessed. Further exploration along this line of inquiry could be undertaken to understand the aspects of satisfaction and perceived quality of care that are significantly associated with burnout.

An additional limitation of the existing body of literature is the reliance on cross-sectional study designs. Cross-sectional design limits conclusions regarding causality. Cross-sectional data does not distinguish the sequence of conditions. For example, did burnout cause decreased quality of care? Or, did decreased quality of care cause burnout? At best, the cross-sectional data used in these studies can only be used to determine that there is a relationship. At that same time, there is evidence from studies that have used longitudinal data to examine burnout and medical errors among residents that there is a causal relationship such that burnout causes errors.[62] However, the longitudinal data that contributes to the strength of West et al.'s [62] is potentially weakened by the self-reported medical errors.

Finally, only two studies[5,29] described the population from which the study sample was drawn. Thus, it is difficult to determine whether there was a difference between the study participants and non-participants. To aid in the interpretation of the results (i.e., the generalizability), it would be useful for future studies to report this type of information.

Strengths and Limitations of the Search Strategy

Although six databases were used in the search, articles that did not appear in any of the databases would have been missed. To decrease the possibility of this occurring, we employed a broad scope in development of the search terms for each database and followed this with a hand search of included articles. Another potential limitation is the fact that the search focused on articles published in English-language journals. However, despite the English-language constraint, the identified studies originated in European, Middle Eastern, North American and Asian countries. This indicates that although the research was not conducted in countries where English is the first language, at least some of these researchers publish in English-language journals. Finally, there is also a potential limitation associated with focusing on published peer-reviewed articles. In doing so, we may be subject to publication bias.[63] At the same time, the quality of the gray literature has been questioned because it is not necessarily subject to critical assessment prior to being published.[64] As a result, unpublished studies may be of lower quality and have greater risk of bias in their study designs.

CONCLUSIONS

The focus on quality related to direct care can highlight additional ways that physician burnout affects the healthcare system. These results contribute evidence about whether the effects of physician burnout are limited to physicians or whether consequences of physician burnout are more extensive. They also can help to inform decisions about how to improve

patient care by addressing physician burnout. That is, decisions can be informed when confronting a question of how to improve quality of patient care. There are a number of ways in which this may be done through investment in capital such as new technologies. The results of this systematic review suggest that an alternative investment could be in human resources as represented by physician staff.

The results of this systematic literature review suggest that there is moderate evidence that burnout is associated with safety-related quality of care. Because of the variability in the way patient acceptability-related quality of care was measured and the inconsistency in study findings, the evidence supporting the relationship between burnout and patient acceptability-related quality of care is less strong. Future research evaluating burnout interventions for physicians could consider looking at safety-related quality of care to assess the effectiveness of these interventions. Continued work looking at the relationship between dimensions of acceptability-related quality of measures and burnout is warranted.

DATA SHARING STATEMENT

All the published papers used in this manuscript are publicly available. There are no data available.

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COMPETING INTERESTS

The authors declare that they have no competing interests.

CONTRIBUTORSHIP STATEMENT

CSD led the conception, design, data acquisition, analysis and interpretation of the data; she also led the writing of the overall manuscript. DL collaborated on the design, data acquisition and analysis; he contributed to the writing of the overall manuscript and led the writing of the Methods section. SB collaborated on the design and data acquisition and contributed to the writing of the manuscript. LT collaborated on the data acquisition and analysis. All authors read and approved the final manuscript. All authors are guarantors of the final manuscript.

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FIGURES, TABLES AND SUPPLEMENTARY FILES LEGEND

Figure 1. Flowchart of Accepted/ Rejected Articles

Figure 2. Summary of Risk of Bias Across Studies

Table 1. Description of the Studies

Table 2. Patient Safety and Acceptability Related Quality of Care Outcomes

Supplementary File 1: Search Terms Used in Search Strategy

Supplementary File 2: Risk of Bias Assessment Checklist

Supplementary File 3: PRISMA Checklist

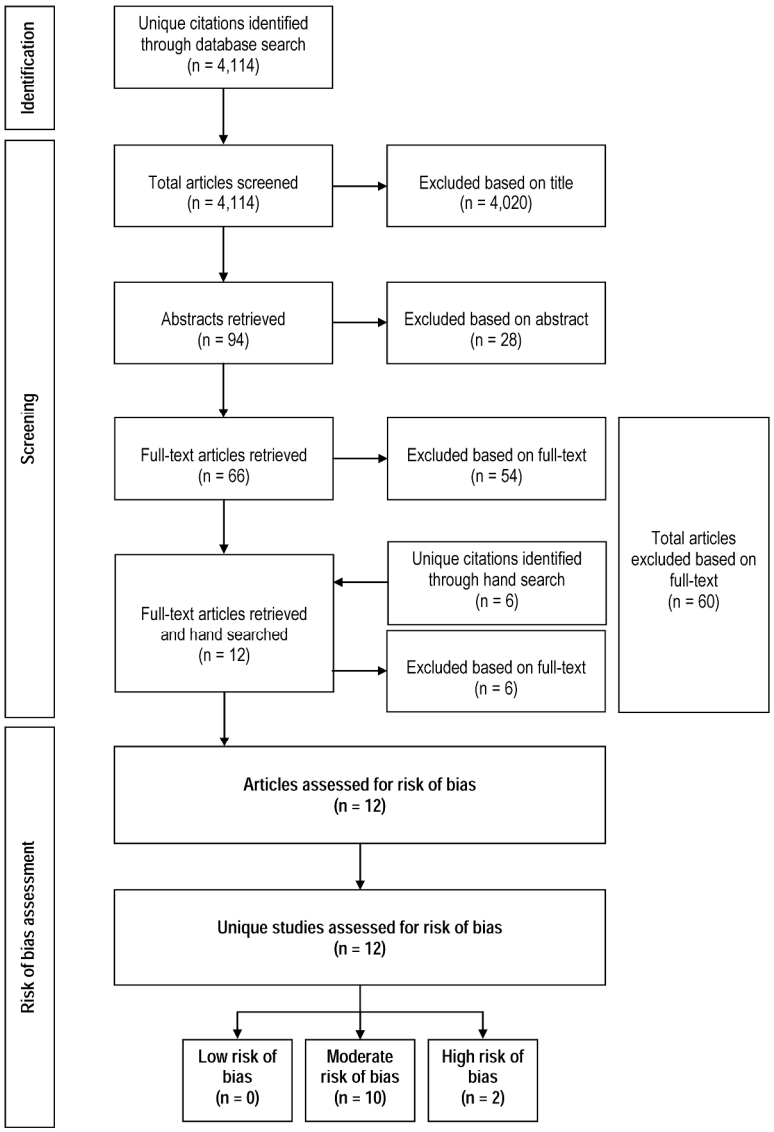

Figure 1. Flowchart of Accepted/ Rejected Articles

279x361mm (300 x 300 DPI)

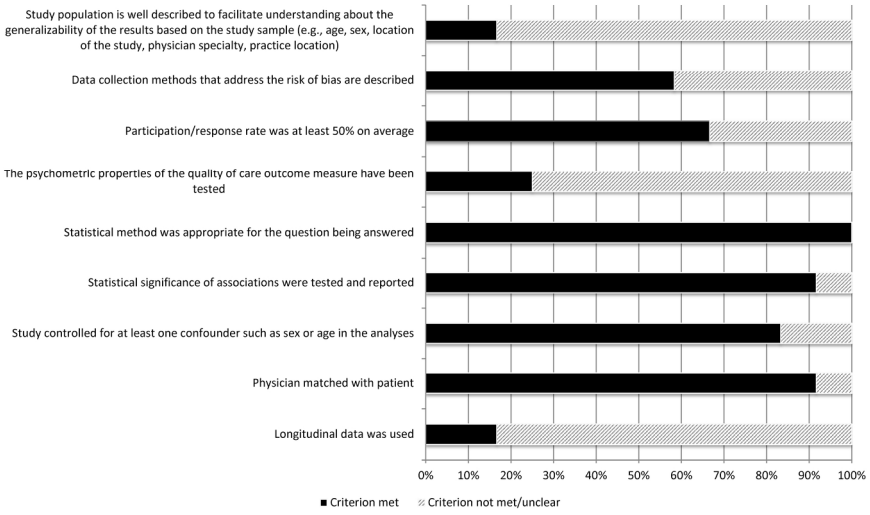

Figure 2. Summary of Risk of Bias Across Studies

215x166mm (300 x 300 DPI)

Search terms used in search strategy

Database	Search Terms
Medline Current	[exp Burnout, Professional/ OR burnout.mp. OR (burnout adj3 effect$).mp.] AND [exp Physicians/ OR exp Psychiatry/ OR allergist$.mp. OR anesthesiologist$.mp. OR cardiologist$.mp. OR clinical pharmacologist$.mp. OR clinical toxicologist$.mp. OR dermatologist$.mp. OR doctor$.mp. OR endocrinologist$.mp. OR gastroenterologist$.mp. OR gynecologist$.mp. OR hematologist$.mp. OR immunologist$.mp. OR medical biochemist$.mp. OR medical geneticist$.mp. OR medical microbiologist$.mp. OR nephrologist$.mp. OR neurologist$.mp. OR neuropathologist$.mp. OR neuroradiologist$.mp. OR occupational physician$.mp. OR oncologist$.mp. OR ophthalmologist$.mp. OR pathologist$.mp. OR pediatrician$.mp. OR physician$.mp. OR psychiatrist$.mp. OR radiologist$.mp. OR rheumatologist$.mp. OR surgeon$.mp. OR urologist$.mp.] AND [exp Diagnostic Errors/ OR exp Medical Errors/ OR exp Medication Errors/ OR exp "Quality of Health Care"/ OR exp Quality Assurance, Health Care/ OR misdiag$.mp. OR (diagnos$ adj3 error$).mp. OR (medical$ adj3 error$).mp. OR (medication$ adj3 error$).mp. OR (drug$ adj3 error$).mp. OR (mistak$ adj3 medic$).mp. OR (surgic$ adj3 error$).mp. OR (quality$ adj3 health$ adj3 care$).mp. OR (quality$ adj3 healthcare$).mp. OR (quality$ adj3 of adj3 care$).mp. OR exp Professional Competence/ OR (professional$ adj3 competenc$).mp. OR (technical$ adj3 expertise$).mp. OR (expertise$ adj3 generaliz$).mp. OR professionalism$.mp. OR exp Treatment Outcome/ OR (treat$ adj3 outcome$).mp. OR (patient$ adj3 outcome$).mp. OR exp Professional Impairment/ OR (impair$ adj3 physician$).mp. OR (impair$ adj3 doctor$).mp. OR (disruptive$ adj3 behav$).mp. OR exp Safety/ OR safe$.mp. OR exp Risk/ OR risk$.mp. OR exp Patient Satisfaction/ OR (patient$ adj3 satisf$).mp. OR (client$ adj3 satisf$).mp. OR exp Professional-Patient Relations/ OR (professional$ adj3 patient$ adj3 relation$).mp. OR (client$ adj3 contact$).mp. OR exp Physician-Patient Relations/ OR (physician$ adj3 patient$ adj3 relation$).mp. OR (doctor$ adj3 patient$ adj3 relation$).mp. OR exp Communication/ OR communicat$.mp. OR misinform$.mp. OR exp Health Communication/ OR exp "Attitude of Health Personnel"/ OR attitude$.mp. OR exp Clinical Competence/ OR (clinical$ adj3 competenc$).mp. OR (clinical$ adj3 skill$).mp. OR exp Patient-Centered Care/ OR (patient$ adj3 cent$ adj3 care$).mp. OR (patient$ adj3 focus$ adj3 care$).mp. OR exp Empathy/ OR empath$.mp. OR exp Patient Care/ OR (patient$ adj3 care$).mp. OR (informal$ adj3 care$).mp. OR exp "Standard of Care"/ OR (standard$ adj3 care$).mp. OR st.fs. [standards - floating subheading] OR exp Self Efficacy/ OR efficacy$.mp. OR exp Clinical Audit/ OR audit$.mp. OR exp Medical Audit/ OR (diagnos$ adj3 mistak$).mp. OR (medication$ adj3 mistak$).mp. OR (drug$ adj3 mistak$).mp. OR (surgic$ adj3 mistak$).mp. OR exp Safety Management/ OR (program$ adj3 hazard$ adj3 surveillance$).mp. OR (management$ adj3 safety$).mp. OR (hazard$ adj3 control$).mp. OR (hazard$ adj3 management$).mp. OR exp Malpractice/ OR malpractic$.mp. OR negligen$.mp. OR exp Morbidity/ OR morbidit$.mp. OR exp Postoperative Complications/ OR (postoperative$ adj3 complication$).mp. OR exp Cross Infection/ OR (nosocomial$ adj3 infection$).mp. OR (hospital$ adj3 infection$).mp. OR (cross$ adj3 infection$).mp. OR exp Physician's Practice Patterns/ OR (practice$ adj3 pattern$ adj3 clinical$).mp. OR (practice$ adj3 pattern$ adj3 physician$).mp. OR (prescribing$ adj3 pattern$ adj3 physician$).mp. OR (practice$ adj3 pattern$ adj3 professional$).mp. OR (practice$ adj3 pattern$ adj3 variation$).mp. OR (practice$ adj3 clinical$ adj3 variation$).mp. OR (practice$ adj3 medical$ adj3 variation$).mp. OR exp Mortality/ OR (rate$ adj3 age-specific$ adj3 death$).mp. OR (rate$ adj3 death$).mp. OR (rate$ adj3 fatalit$).mp. OR mortalit$.mp. OR exp "Outcome Assessment (Health Care)"/ OR (measure$ adj3 outcome$).mp. OR (assessment$ adj3 outcome$).mp. OR (research$ adj3 outcome$).mp. OR (stud$ adj3 outcome$).mp. OR (assessment$ adj3 patient$ adj3 outcome$).mp. OR (research$ adj3 patient$ adj3 outcome$).mp. OR exp Risk Reduction Behavior/ OR exp Risk-Taking/ OR exp "Root Cause Analysis"/ OR (cause$ adj3 root$ adj3 analys$).mp. OR exp "Drug-Related Side Effects and Adverse Reactions"/ OR (drug$ adj3 side$ adj3 effect$).mp. OR (drug$ adj3 toxic$).mp. OR (drug$ adj3 reaction$ adj3 adverse$).mp. OR (drug$ adj3 event$ adj3 adverse$).mp. OR ae.fs. [adverse effects floating subheading] OR mo.fs. [mortality floating subheading] OR po.fs. [poisoning floating subheading] OR to.fs. [toxicity floating subheading] OR in.fs. [injuries floating subheading]]
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Medline Epub Ahead of Print	[exp Burnout, Professional/ OR burnout.mp. OR (burnout adj3 effect$).mp.] AND [exp Physicians/ OR exp Psychiatry/ OR allergist$.mp. OR anesthesiologist$.mp. OR cardiologist$.mp. OR clinical pharmacologist$.mp. OR clinical toxicologist$.mp. OR dermatologist$.mp. OR doctor$.mp. OR endocrinologist$.mp. OR gastroenterologist$.mp. OR gynecologist$.mp. OR hematologist$.mp. OR immunologist$.mp. OR medical biochemist$.mp. OR medical geneticist$.mp. OR medical microbiologist$.mp. OR nephrologist$.mp. OR neurologist$.mp. OR neuropathologist$.mp. OR neuroradiologist$.mp. OR occupational physician$.mp. OR oncologist$.mp. OR ophthalmologist$.mp. OR pathologist$.mp. OR pediatrician$.mp. OR physician$.mp. OR psychiatrist$.mp. OR radiologist$.mp. OR rheumatologist$.mp. OR surgeon$.mp. OR urologist$.mp.] AND [exp Diagnostic Errors/ OR exp Medical Errors/ OR exp Medication Errors/ OR exp "Quality of Health Care"/ OR exp Quality Assurance, Health Care/ OR misdiag$.mp. OR (diagnos$ adj3 error$).mp. OR (medical$ adj3 error$).mp. OR (medication$ adj3 error$).mp. OR (drug$ adj3 error$).mp. OR (mistak$ adj3 medic$).mp. OR (surgic$ adj3 error$).mp. OR (quality$ adj3 health$ adj3 care$).mp. OR (quality$ adj3 healthcare$).mp. OR (quality$ adj3 of adj3 care$).mp. OR exp Professional Competence/ OR (professional$ adj3 competenc$).mp. OR (technical$ adj3 expertise$).mp. OR (expertise$ adj3 generaliz$).mp. OR professionalism$.mp. OR exp Treatment Outcome/ OR (treat$ adj3 outcome$).mp. OR (patient$ adj3 outcome$).mp. OR exp Professional Impairment/ OR (impair$ adj3 physician$).mp. OR (impair$ adj3 doctor$).mp. OR (disruptive$ adj3 behav$).mp. OR exp Safety/ OR safe$.mp. OR exp Risk/ OR risk$.mp. OR exp Patient Satisfaction/ OR (patient$ adj3 satisf$).mp. OR (client$ adj3 satisf$).mp. OR exp Professional-Patient Relations/ OR (professional$ adj3 patient$ adj3 relation$).mp. OR (client$ adj3 contact$).mp. OR exp Physician-Patient Relations/ OR (physician$ adj3 patient$ adj3 relation$).mp. OR (doctor$ adj3 patient$ adj3 relation$).mp. OR exp Communication/ OR communicat$.mp. OR misinform$.mp. OR exp Health Communication/ OR exp "Attitude of Health Personnel"/ OR attitude$.mp. OR exp Clinical Competence/ OR (clinical$ adj3 competenc$).mp. OR (clinical$ adj3 skill$).mp. OR exp Patient-Centered Care/ OR (patient$ adj3 cent$ adj3 care$).mp. OR (patient$ adj3 focus$ adj3 care$).mp. OR exp Empathy/ OR empath$.mp. OR exp Patient Care/ OR (patient$ adj3 care$).mp. OR (informal$ adj3 care$).mp. OR exp "Standard of Care"/ OR (standard$ adj3 care$).mp. OR st.fs. [standards - floating subheading] OR exp Self Efficacy/ OR efficacy$.mp. OR exp Clinical Audit/ OR audit$.mp. OR exp Medical Audit/ OR (diagnos$ adj3 mistak$).mp. OR (medication$ adj3 mistak$).mp. OR (drug$ adj3 mistak$).mp. OR (surgic$ adj3 mistak$).mp. OR exp Safety Management/ OR (program$ adj3 hazard$ adj3 surveillance$).mp. OR (management$ adj3 safety$).mp. OR (hazard$ adj3 control$).mp. OR (hazard$ adj3 management$).mp. OR exp Malpractice/ OR malpractic$.mp. OR negligen$.mp. OR exp Morbidity/ OR morbidit$.mp. OR exp Postoperative Complications/ OR (postoperative$ adj3 complication$).mp. OR exp Cross Infection/ OR (nosocomial$ adj3 infection$).mp. OR (hospital$ adj3 infection$).mp. OR (cross$ adj3 infection$).mp. OR exp Physician's Practice Patterns/ OR (practice$ adj3 pattern$ adj3 clinical$).mp. OR (practice$ adj3 pattern$ adj3 physician$).mp. OR (prescribing$ adj3 pattern$ adj3 physician$).mp. OR (practice$ adj3 pattern$ adj3 professional$).mp. OR (practice$ adj3 pattern$ adj3 variation$).mp. OR (practice$ adj3 clinical$ adj3 variation$).mp. OR (practice$ adj3 medical$ adj3 variation$).mp. OR exp Mortality/ OR (rate$ adj3 age-specific$ adj3 death$).mp. OR (rate$ adj3 death$).mp. OR (rate$ adj3 fatalit$).mp. OR mortalit$.mp. OR exp "Outcome Assessment (Health Care)"/ OR (measure$ adj3 outcome$).mp. OR (assessment$ adj3 outcome$).mp. OR (research$ adj3 outcome$).mp. OR (stud$ adj3 outcome$).mp. OR (assessment$ adj3 patient$ adj3 outcome$).mp. OR (research$ adj3 patient$ adj3 outcome$).mp. OR exp Risk Reduction Behavior/ OR exp Risk-Taking/ OR exp "Root Cause Analysis"/ OR (cause$ adj3 root$ adj3 analys$).mp. OR exp "Drug-Related Side Effects and Adverse Reactions"/ OR (drug$ adj3 side$ adj3 effect$).mp. OR (drug$ adj3 toxic$).mp. OR (drug$ adj3 reaction$ adj3 adverse$).mp. OR (drug$ adj3 event$ adj3 adverse$).mp. OR ae.fs. [adverse effects floating subheading] OR mo.fs. [mortality floating subheading] OR po.fs. [poisoning floating subheading] OR to.fs. [toxicity floating subheading] OR in.fs. [injuries floating subheading]]

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PsycINFO	[burnout.mp. OR (burnout adj3 effect$).mp.] AND [exp physicians/ OR exp clinicians/ OR exp Psychiatry/ OR allergist$.mp. OR anesthesiologist$.mp. OR cardiologist$.mp. OR clinical pharmacologist$.mp. OR clinical toxicologist$.mp. OR dermatologist$.mp. OR doctor$.mp. OR endocrinologist$.mp. OR gastroenterologist$.mp. OR gynecologist$.mp. OR hematologist$.mp. OR immunologist$.mp. OR medical biochemist$.mp. OR medical geneticist$.mp. OR medical microbiologist$.mp. OR nephrologist$.mp. OR neurologist$.mp. OR neuropathologist$.mp. OR neuroradiologist$.mp. OR occupational physician$.mp. OR oncologist$.mp. OR ophthalmologist$.mp. OR pathologist$.mp. OR pediatrician$.mp. OR physician$.mp. OR psychiatrist$.mp. OR radiologist$.mp. OR rheumatologist$.mp. OR surgeon$.mp. OR urologist$.mp.] AND [exp Errors/ OR exp "Quality of Care"/ OR misdiag$.mp. OR (diagnos$ adj3 error$).mp. OR (medical$ adj3 error$).mp. OR (medication$ adj3 error$).mp. OR (drug$ adj3 error$).mp. OR (mistak$ adj3 medic$).mp. OR (surgic$ adj3 error$).mp. OR (quality$ adj3 health$ adj3 care$).mp. OR (quality$ adj3 healthcare$).mp. OR (quality$ adj3 of adj3 care$).mp. OR exp Professional Competence/ OR (professional$ adj3 competenc$).mp. OR (technical$ adj3 expertise$).mp. OR (expertise$ adj3 generaliz$).mp. OR professionalism$.mp. OR exp Treatment Outcome/ OR (treat$ adj3 outcome$).mp. OR (patient$ adj3 outcome$).mp. OR exp Impaired Professionals/ OR (impair$ adj3 physician$).mp. OR (impair$ adj3 doctor$).mp. OR (disruptive$ adj3 behav$).mp. OR exp Safety/ OR safe$.mp. OR exp Risk Factors/ OR exp Risk Management/ OR exp Risk Assessment/ OR risk$.mp. OR exp Client Satisfaction/ OR (patient$ adj3 satisf$).mp. OR (client$ adj3 satisf$).mp. OR exp Therapeutic Processes/ OR (professional$ adj3 patient$ adj3 relation$).mp. OR (client$ adj3 contact$).mp. OR (physician$ adj3 patient$ adj3 relation$).mp. OR (doctor$ adj3 patient$ adj3 relation$).mp. OR exp Communication/ OR communicat$.mp. OR misinform$.mp. OR exp Communication Skills/ OR exp Communication Barriers/ OR exp Health Personnel Attitudes/ OR attitude$.mp. OR exp Competence/ OR (clinical$ adj3 competenc$).mp. OR (clinical$ adj3 skill$).mp. OR exp Client Centered Therapy/ OR (patient$ adj3 cent$ adj3 care$).mp. OR (patient$ adj3 focus$ adj3 care$).mp. OR exp Empathy/ OR empath$.mp. OR exp Patients/ OR (patient$ adj3 care$).mp. OR (informal$ adj3 care$).mp. OR exp Professional Standards/ OR (standard$ adj3 care$).mp. OR exp Self Efficacy/ OR efficacy$.mp. OR exp Clinical Audits/ OR audit$.mp. OR (diagnos$ adj3 mistak$).mp. OR (medication$ adj3 mistak$).mp. OR (drug$ adj3 mistak$).mp. OR (surgic$ adj3 mistak$).mp. OR (program$ adj3 hazard$ adj3 surveillance$).mp. OR (management$ adj3 safety$).mp. OR (hazard$ adj3 control$).mp. OR (hazard$ adj3 management$).mp. OR exp Professional Liability/ OR malpractic$.mp. OR negligen$.mp. OR exp Morbidity/ OR morbidit$.mp. OR exp Postoperative Complications/ OR (postoperative$ adj3 complication$).mp. OR (nosocomial$ adj3 infection$).mp. OR (hospital$ adj3 infection$).mp. OR (cross$ adj3 infection$).mp. OR exp Clinical Practice/ OR (practice$ adj3 pattern$ adj3 clinical$).mp. OR (practice$ adj3 pattern$ adj3 physician$).mp. OR (prescribing$ adj3 pattern$ adj3 physician$).mp. OR (practice$ adj3 pattern$ adj3 professional$).mp. OR (practice$ adj3 pattern$ adj3 variation$).mp. OR (practice$ adj3 clinical$ adj3 variation$).mp. OR (practice$ adj3 medical$ adj3 variation$).mp. OR exp Mortality Rate/ OR exp "Death and Dying"/ OR (rate$ adj3 age-specific$ adj3 death$).mp. OR (rate$ adj3 death$).mp. OR (rate$ adj3 fatalit$).mp. OR mortalit$.mp. OR exp Treatment Effectiveness Evaluation/ OR (measure$ adj3 outcome$).mp. OR (assessment$ adj3 outcome$).mp. OR (research$ adj3 outcome$).mp. OR (stud$ adj3 outcome$).mp. OR (assessment$ adj3 patient$ adj3 outcome$).mp. OR (research$ adj3 patient$ adj3 outcome$).mp. OR exp Risk-Taking/ OR exp Error Analysis/ OR (cause$ adj3 root$ adj3 analys$).mp. OR exp "Side Effects (Drug)"/ OR (drug$ adj3 side$ adj3 effect$).mp. OR (drug$ adj3 toxic$).mp. OR (drug$ adj3 reaction$ adj3 adverse$).mp. OR (drug$ adj3 event$ adj3 adverse$).mp. OR exp Toxic Disorders/ OR exp Injuries/ OR 3620.cc. [Personnel Management & Selection & Training classification code] OR 3630.cc. [Personnel Evaluation & Job Performance classification code] OR 3650.cc. [Personnel Attitudes & Job Satisfaction classification code] OR 3670.cc. [Working Conditions & Industrial Safety classification code] OR 3430.cc. [Professional Personnel Attitudes & Characteristics classification code] OR 3450.cc. [Professional Ethics & Standards & Liability code] OR 3470.cc. [Impaired Professionals classification code]]
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Web of Science	[burn out* OR burnout*] AND [physician* OR clinician* OR psychiatry* OR allergist* OR anesthesiologist* OR cardiologist* OR clinical pharmacologist* OR clinical toxicologist* OR dermatologist* OR doctor* OR endocrinologist* OR gastroenterologist* OR gynecologist* OR hematologist* OR immunologist* OR medical biochemist* OR medical geneticist* OR medical microbiologist* OR nephrologist* OR neurologist* OR neuropathologist* OR neuroradiologist* OR occupational physician* OR oncologist* OR ophthalmologist* OR pathologist* OR pediatrician* OR physician* OR psychiatrist* OR radiologist* OR rheumatologist* OR surgeon* OR urologist* OR consultant*] AND [error* OR health* care*OR healthcare* OR quality* OR misdiag* OR mistak* OR competenc* OR expertis* OR professionalism* OR outcome* OR impair* OR disruptive* OR safe* OR risk* OR satisf* OR relation* OR contact* OR communicat* OR misinform* OR attitude* OR skill* OR care* OR empath* OR standard* OR audit* OR hazard* OR malpractic* OR negligen* OR morbidit* OR infection* OR practice* pattern* OR prescrib* pattern* OR mortalit* OR death* OR fatalit* OR drug* OR adverse* OR poison* OR toxic* OR injur*]

Risk of Bias Assessment Checklist

Author(s)	1	2	3	4	5	6	7	8	9	Total Score
Anagnostopoulos et al. (2012)[31]	0	1	1	1	1	1	1	1	0	7
Halbesleben et al. (2008)[32]	0	0	1	0	1	1	1	1	0	5
Hayashino et al. (2012)[30]	0	1	1	0	1	1	1	1	1	7
Klein et al. (2010)[5]	1	0	1	0	1	1	1	1	0	6
Rabatin et al. (2016)[29]	1	0	1	0	1	0	1	1	1	6
Ratanawongsa et al. (2008)[33]	0	1	0	1	1	1	1	1	0	6
Shanafelt et al. (2010)[42]	0	1	0	0	1	1	1	1	0	5
Shirom et al. (2006)[43]	0	0	1	0	1	1	1	1	0	5
Travado et al. (2005)[34]	0	1	0	0	1	1	0	1	0	4
Weigl et al. (2015)[45]	0	1	1	0	1	1	1	1	0	6
Wen et al. (2016)[46]	0	0	1	0	1	1	1	0	0	4
Weng et al. (2011)[35]	0	1	0	1	1	1	0	1	0	5

Risk of Bias Assessment Criteria

1. Study population is well described to facilitate understanding about the generalizability of the results based on the study sample (e.g., age, sex, location of the study, physician specialty, practice location)
2. Data collection methods that address the risk of bias are described
3. Participation/response rate was at least 50% on average
4. The psychometric properties of the quality of care outcome measure have been tested
5. Statistical method was appropriate for the question being answered
6. Statistical significance of associations were tested and reported
7. Study controlled for at least one confounder such as sex or age in the analyses
8. Physician matched with patient
9. Longitudinal data was used

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	4-5
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4-5
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	N/A
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	7-9
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	7
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	7-11 Supp. File 1
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	11-12
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	N/A
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	11-12
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	12
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	N/A
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	N/A

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	12
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	N/A
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	11, Fig. 1
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	12-22, Table 1
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	12, Supp. File 2
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	22-26, Table 2
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	N/A
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	12, Fig. 2
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	N/A
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	26-27
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	27-29
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	30
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	31

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

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The Relationship between Physician Burnout and Quality of Healthcare in terms of Safety and Acceptability – A Systematic Review

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The Relationship between Physician Burnout and Quality of Healthcare in terms of Safety and Acceptability – A Systematic Review

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The Relationship between Physician Burnout and Quality of Healthcare in terms of Safety and Acceptability – A Systematic Review

Abstract

Objectives. This study reviews the current state of the published peer-reviewed literature related to physician burnout and two quality of care dimensions. The purpose of this systematic literature review is to address the question, "How does physician burnout affect the quality of healthcare related to the dimensions of acceptability and safety?"

Design. Using a multi-phase screening process, this systematic literature review is based on publically available peer-reviewed studies published between 2002-2017. Six electronic databases were searched: (1) *Medline Current*, (2) *Medline In-process*, (3) *Medline Epub Ahead of Print*, (4) *PsycINFO*, (5) *Embase*, and (6) *Web of Science*.

Setting. Physicians practicing in civilian settings.

Participants. Practicing physicians who have completed training.

Primary and secondary outcome measures. Quality of healthcare related to acceptability (i.e., patient satisfaction, physician communication, physician attitudes) and safety (i.e., minimizing risks or harm to patients)

Results. 4,114 unique citations were identified. Of these, 12 articles were included in the review. Two studies were rated as having high risk of bias and 10 as having moderate risk. Four studies were conducted in North America; four in Europe, one in the Middle East, and three in East Asia. Results of this systematic literature review suggest there is moderate evidence that burnout is associated with safety-related quality of care. Because of the variability in the way patient acceptability-related quality of care was measured and the inconsistency in study findings, the evidence supporting the relationship between burnout and patient acceptability-related quality of care is less strong.

Conclusions. The focus on direct care-related quality highlights additional ways that physician burnout affects the healthcare system. These studies can help to inform decisions about how to improve patient care by addressing physician burnout. Continued work looking at the relationship between dimensions of acceptability-related quality of care measures and burnout is needed to advance the field.

ARTICLE SUMMARY

STRENGTHS AND LIMITATIONS OF THIS STUDY:

- Few studies have examined the current state of knowledge about the relationship between physician burnout and the patient safety and acceptability dimensions of quality of care.

- This systematic literature review employed a broad search of six electronic databases: (1) *Medline Current*, (2) *Medline In-process*, (3) *Medline Epub Ahead of Print*, (4) *PsycINFO*, (5) *Embase*, and (6) *Web of Science*. A manual search was also conducted. In total, 4,114 unique citations were identified and reviewed by three reviewers in pairs.

- We used a comprehensive search strategy that follows the recommended best practices of incorporating adjacency commands and synonyms for keywords.

- One of the limitations of the search strategy employed in this systematic review is its focus on English-language publications.

- Another potential limitation of the search strategy is the focus on published peer-reviewed articles. In doing so, our results may be subject to publication bias.

The Relationship between Physician Burnout and Quality of Healthcare in terms of Safety and Acceptability – A Systematic Review

Reports from around the world indicate that about one-third to one-half of physicians experience at least one dimension of burnout.[1-5] Burnout has been conceptualized as a syndrome consisting of three dimensions: emotional exhaustion (EE), depersonalization (DP) and low personal accomplishment (PA).[6] Maslach et al.[7] define EE as referring to "feelings of being overextended and depleted of one's emotional and physical resources." DP is also referred to as cynicism and defined as "a negative, callous, or excessively detached response to various aspects".[7] PA is also referred to as professional efficacy and "it refers to feelings of incompetence and a lack of achievement and productivity at work".[7] Burnout has been observed to affect personal well-being through low job satisfaction[8-10] and decreased mental health.[11]

Because physicians play an integral role in the healthcare system, the effects of physician burnout are not limited to the physicians experiencing it. Rather, physician burnout potentially impacts the entire healthcare system. For example, a recent systematic literature review reported a negative relationship between burnout and productivity (i.e., early retirement, work cutback, and quitting).[12] The impact of productivity loss related to burnout could lead to fewer available healthcare resources that in turn, can result in healthcare service waitlists. One estimate of the costs of physician work cutback and early retirement related to burnout suggests it totals to at least CAD $213 million in patient services losses.[8]

This raises another question about physicians who continue to practice despite experiencing burnout. Does burnout affect their practice? There is evidence that physician burnout is also related to decreased quality of patient care.[5] The World Health Organization (WHO)[13] and the Institute of Medicine (IOM)[14] suggest that there are six dimensions for quality of healthcare: effectiveness, efficiency, accessibility, equitability, acceptability, and safety.

The purpose of this systematic literature review is to address the question, "How does physician burnout affect the quality of healthcare related to the dimensions of acceptability and safety?" In this review, we focus on two dimensions of quality – acceptability (i.e., patient satisfaction, perceived quality of care, and communication) and safety (i.e., minimizing risks or harm to patients). We choose these two dimensions because they reflect the quality of patient-physician interactions.[15] That is, if a clinician's wellbeing is compromised, their patient interactions may also be negatively affected.[16] In contrast, effectiveness, efficiency, accessibility, equitability reflect the systems (i.e., infrastructure, information technology, payment policies) in which practice is conducted.[14]

Background

There has been growing interest in the relationship between healthcare professional wellbeing and quality of patient care. Although the WHO[13] and IOM[14] identify six dimensions of quality of healthcare, attention has focused on the dimension of patient safety. Recently, there have been four published reviews that focus on the relationship between healthcare professional wellbeing and patient safety.[17-20] For example, Hall et al.[18] consider healthcare staff wellbeing and Salyers et al. [20] examine staff burnout as opposed to specifically examining physician burnout as our review does. de Jong et al.[17] examine common mental disorders as opposed to burnout. Williams and Skinner[19] look at physician satisfaction rather than burnout. Each of these published reviews answer questions that are different from the one addressed in our review. Because they seek to answer different questions, they employ search strategies and inclusion/exclusion criteria that are different from those used in our review. Consequently, they include different articles. For example, Hall et al.'s[18] review does not include nine articles that are in included in our systematic review. Among these, there are six articles related to

acceptability and three articles related to patient safety that were not included in Hall et al.'s[18] review. In comparison to de Jong et al.'s review,[17] our review has six articles on acceptability and five on patient safety that are unique to our systematic review. None of the articles included in our review were included in Williams and Skinner's.[19] Compared to the papers included in Salyers et al.'s[20] review, there are four papers related to physician burnout and safety that are unique to our review and two focused on acceptability that are unique to our review. Thus, our review includes papers that have not been considered together to look at quality of care related to physician interactions with patients and the impact of burnout on physicians.

In addition, none of the published reviews considers the quality of care dimension of acceptability for physicians who have completed training. Yet, along with patient safety, this dimension reflects the quality of interactions between providers and patients. The physician-patient interactions are one of the fundamental interactions in healthcare.[15,19] Furthermore, the IOM[14] asserts that the rise in chronic illnesses necessitates quality interactions to enhance the collaboration between the physician and patient. Quality of physician-patient interactions is reflected in communication, perceived quality of care, and patient satisfaction.[14,15] It is the physician-patient interaction that supports the collaboration that will lead to better patient outcomes.[15]

Wallace et al.[16] assert that physician wellbeing could be used as a quality indicator. The argument could be strengthened by also understanding how wellbeing is associated with the physician-patient interaction-related quality dimensions of safety and acceptability. In particular, burnout could be a focus because it reflects wellbeing and there are standardized measures to identify it. Furthermore, it is a facet of wellbeing that can be influenced by organizational factors and is under the influence of the healthcare system.[16,21,22] Thus, this systematic review of

the literature extends our knowledge about the dimensions of quality of care that reflect physician interactions with patients and a dimension of wellbeing that is affected by the work environment.

METHODS

A systematic review of the literature was reported following the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA) guidelines (Supplementary File 1: PRISMA Checklist).[23] Ethics board review was not sought because this review relied solely on publicly available sources of information.

Information Sources

Six databases were searched: (1) *Medline Current* (index of biomedical research and clinical sciences journal articles); (2) *Medline In-Process* (index of biomedical research and clinical sciences journal articles awaiting to be indexed into *Medline Current*); (3) *Medline Epub Ahead of Print* (index of articles that appear on publisher websites in advance of the journal release) (4) *PsycINFO* (an index of journal articles, books, chapters, and dissertations in psychology, social sciences, behavioral sciences, and health sciences); (5) *Embase* (index of biomedical research, and abstracts from biomedical, drug and medical device conferences); and (6) *Web of Science* (index of journal articles, editorially selected books and conference proceedings in life sciences and biomedical research).

Search Strategy

Collaborating with the professional health science librarian (SB) member of this research team, search strategies were developed and tailored for each database following the Peer Review of Electronic Search Strategies (PRESS) guidelines[24] (Supplementary File 2: Search terms used

in search strategy). Because recommended guidelines were used for this review's search strategies, the search strategy that we used is also a contribution to the literature. As this literature grows, the strategy can be used in future searches on the topic. The searches were conducted in February 2017. The OVID platform was used to search *Medline Current*, *Medline In-Process*, *Medline Epub Ahead of Print*, *PsycINFO*, and *Embase*. *Web of Science* was searched using the Thomson Reuters search interface. The search period covered January 2002 – February 2017; all searches were limited to English language journals. The time frame was chosen to represent the current healthcare environments in which physicians are practicing. For example, the year 2002 was the year after the Institute of Medicine's report[14] on the quality of healthcare that discussed the six dimensions of quality of care. By beginning in 2002, we have allowed for a one year lag after publication of this report during which healthcare settings and researchers could have incorporated the Institute of Medicine's quality of healthcare framework into their work.

Our searches sought to identify articles about practicing physicians regardless of specialty working in civilian settings (i.e., non-military settings). In this review, the physician search included: allergists, anesthesiologists, cardiologists, clinical pharmacologists, clinical toxicologists, dermatologists, doctors, endocrinologists, gastroenterologists, gynecologists, hematologists, immunologists, medical biochemists, medical geneticists, medical microbiologists, nephrologists, neurologists, neuropathologists, neuroradiologists, occupational physicians, oncologists, ophthalmologists, pathologists, pediatricians, physicians, psychiatrists, radiologists, rheumatologists, surgeons, and urologists. The search strategy did not seek to exclude residents and medical students. Rather, a broad search strategy was employed to

increase the likelihood that all studies on physician burnout would be found. The reference lists of all accepted full-text articles were hand searched.

Screening process

Relevant articles were identified using a multi-phase screening process that involved reviewer pairs using the inclusion and exclusion criteria for this review. In the first step, titles were screened. Next, abstracts of the articles that remained after the first step were screened. The final step of the process involved screening the full text of all articles that passed the first and second phases. In the full text screening, papers for which there was insufficient information in the title and abstract to determine relevancy were also included. Two pairs of reviewers (CSD and LT, CSD and DL) independently completed the multi-phase screening process. The inter-rater reliability corrected for chance[25] between CSD & LT and CSD & DL was $\kappa = 0.96$ and $\kappa = 0.98$, respectively. Before moving onto each stage, disagreements were discussed until consensus was reached.

For this review, burnout was defined as a syndrome of emotional exhaustion, cynicism (depersonalization) and reduced feelings of personal accomplishment related to work.[6] Quality of care related to acceptability was identified with measures reflecting physician-patient interactions such as patient satisfaction, perceived quality of care, physician communication with patients, and physician attitudes towards patients. In addition, safety was identified by measures that reflected risks or harm to patients such as medical errors.

Study inclusion criteria were:

1. Studies reported quality of care outcomes related to acceptability and/or safety
2. The sample population was comprised of practicing physicians regardless of specialty who worked in civilian settings. That is, the results were reported such

that the practicing physician (as opposed to resident) outcomes were reported separately.

3. Burnout was assessed based on a psychometrically validated measure
4. Paper reports original research

Exclusion criteria were:

1. The study sample was comprised only of residents and medical students
2. The study did not examine the relationship between burnout and one of the two quality of care dimensions
3. Burnout was not assessed based on a validated measure
4. The paper was a review article or commentary

Risk of Bias Assessment

All included articles were assessed for risk of bias by both pairs of reviewers (CSD & LT, and CSD & DL). Disagreements between the pairs of reviewers were discussed until consensus was reached.

To assess the risk of bias in observational studies, Sanderson et al.[26] recommend the use of a transparent checklist that concentrates on the "few, principal, and potential sources of bias in a study's findings". They assert that the fundamental domains should include: (1) the appropriate selection of participants, (2) appropriate measurement of variables, and (3) appropriate control of confounding. In accordance with their recommendations and the Strengthening of Observational Studies in Epidemiology (STROBE) criteria,[27] a 9-item risk of bias checklist with the following criteria adapted from Lagerveld et al.[28] was used:

1. Study population is well described to facilitate understanding about the generalizability of the results based on the study sample (e.g., age, sex, location of the study, physician specialty, practice location)
2. Data collection methods that address the risk of bias are described
3. Participation/response rate was at least 50% on average

4. The psychometric properties of the quality of care outcome measure have been tested
5. Statistical method was appropriate for the question being answered
6. Statistical significance of associations were tested and reported
7. Study controlled for at least one confounder such as sex or age in the analyses
8. Physician matched with patient
9. Longitudinal data was used

Each item was scored "1" if the criterion had been met. Each article could achieve a maximum score of 9. Based on their total score, articles were categorized either as low (8-9 points), moderate (5-7 points), or high risk of bias (1-4 points).

RESULTS

Article Inclusion and Exclusion Results

The electronic literature search resulted in the identification of 4,114 unique citations (Figure 1). Based on the title review, 4,020 citations were excluded; this left 94 articles for abstract review. During the abstract review, another 28 citations were excluded; this left 66 articles for full-text review. Reasons for article exclusions at full text review were: (1) not a relevant outcome (n = 10), (2) sample not comprised of physicians/cannot distinguish physicians as a group from other clinicians (n = 15), (3) it was not original research (n = 20), (4) burnout not measured with a validated instrument (n = 1), and (5) not published in a peer-reviewed journal (n = 8). After the full-text review, 12 articles remained and their reference lists were hand searched for relevant studies. The hand search identified six additional citations; all six were excluded at full-text review.

Insert Figure 1

Risk of Bias Assessment Results

Our assessment indicated 10 of the 12 studies were of moderate risk of bias; two were of high risk of bias. Figure 2 illustrates the limitations of these studies. Two studies comprehensively[5,29] described the study population from which the study sample was drawn. Two studies used longitudinal data.[29,30] Other limitations involved not reporting the response rate[31-34] and not controlling for possible confounding factors in the statistical analyses.[34,35] There was also variability in the use of validated outcome measures; only three studies used validated instruments to measure their outcomes. [31,33,35] All included studies employed appropriate statistical tests. All but one[29] reported the results of the statistical testing (Supplementary File 3: Risk of Bias Assessment Checklist).

Insert Figure 2

Overview of the Studies

Of the 12 studies that met the inclusion criteria (Table 1), four were conducted in the US, two in Germany, one each in Greece, Israel, Japan, China, and Taiwan. There was one multi-national study based on data from Italy, Spain, and Portugal.

Table 1. Study Descriptions and Reported Patient Safety and Acceptability Related Quality of Care Outcomes

Author(s)	Study Population	Description of Sample	Burnout Measure	Quality of Care Measure	Quality of Care Outcomes		
					Medical Errors (ME)	Patient Satisfaction (PS)/Quality of Care (QoC)	Communication/Attitudes
Anagnostopoulos et al. (2012)[31] Greece	Physicians working in three large primary health care centers. Patients of participating physicians. Patients selected through systematic random sampling – 1:3 consecutive patients. Physician response rate: 85.8% Patient response rate: Not reported	n = 30 physicians ≤ 10 years practicing: 53% Specialties: General practitioners: 63% Pathologists/internists: 23.3% Male: n = 17 Female: n = 13 > 50 yrs: 43% 26−50 yrs: 40% n = 300 patients Male: 46% Female: 54% Mean age: 54 ± 15 yrs	Greek translation of the 22−item Maslach Burnout Inventory−Human Services Survey	Patient report: Patient satisfaction assessed using 18−item Consultation Satisfaction Questionnaire.[36] 5−point Likert scale from 1 = "strongly agree" to 5 = "strongly disagree". Satisfaction sub−scales: (1) General, (2) Perceived length of consultation, (3) Depth of relationship, (4) Professional care provided Overall satisfaction: sum of all items (max score = 90) Scale was translated into Greek using back−translation and pilot testing. English version's psychometric properties tested.[36,37]		Correlation btwn Maslach Burnout Inventory (MBI) dimensions and PS: • EE & PS: r = −0.64, p<0.01 • DP & PS: r = −0.54, p<0.01 • PA & PS: r = 0.26, p=0.17 Results of mixed effect model with PS as outcome: • Low EE associated with highest average PS Comparison btwn moderate and high EE no significant difference in association with PS	
Halbesleben and Rathert (2008)[32] USA	Attending physicians of university students who had been hospitalized in past year. Student response rate: Not reported	n = 178 physicians Yrs practicing: Not reported Specialties: Not reported Male: n = 84 Female: n = 94 Mean age = 46 ± 13 yrs n = 178 patients Male: n = 98 Female: n = 80 Mean age: 23 ± 5 yrs	22−item Maslach Burnout Inventory−Human Services Survey modified to apply to patients rather than general care recipients	Patient report: Patient satisfaction assessed using 22−item SERVQUAL.[38] 7−point Likert scale from 1 = "strongly disagree" to 7 = "strong agree". Psychometric properties tested but subsequent study suggested need for further exploration regarding its validity.[39]		Correlation btwn MBI dimensions and PS: DP & PS: r = −0.16, p<0.05	

Author(s)	Study Population	Description of Sample	Burnout Measure	Quality of Care Measure	Quality of Care Outcomes		
					Medical Errors (ME)	Patient Satisfaction (PS)/Quality of Care (QoC)	Communication/Attitudes
Hayashino et al. (2012)[30] Japan	Members of a panel of 6,459 hospital−based physicians recruited through hospital lists and scientific meetings. A randomly selected sub−sample of 1,198 were invited to participate. Response rate: 70%	n = 836 physicians Yrs practicing: Not reported Male: 92% Female: 8% 28−39 yrs: 23% 40−49 yrs: 47% 50−59 yrs: 26% 60−81 yrs: 4%	17−item Maslach Burnout Inventory developed for Japanese healthcare professionals based on the MBI−Human Services Survey Used burnout thresholds: EE: ≥ 21 DP: ≥ 18 PA: ≥ 16	Physician report: Perceived medical errors assessed with questions: "Are you concerned that you have made any major medical mistakes in the last year?" IF "yes", asked about number of medical errors that concerned respondent. Psychometric properties not tested.	Association btwn MBI dimensions and any medical error: • Significant differences among tertiles for EE (p= 0.026) & DP (p=0.002) % with ME by burnout dimension tertile: EE 1st tertile: 27.9% EE 2nd tertile: 38.2% EE 3rd tertile: 33.9% DP 1st tertile: 35.0% DP 2nd tertile: 27.8% DP 3rd tertile: 37.2% • No significant differences among tertiles for PA (p=0.67)		

Author(s)	Study Population	Description of Sample	Burnout Measure	Quality of Care Measure	Quality of Care Outcomes		
					Medical Errors (ME)	Patient Satisfaction (PS)/Quality of Care (QoC)	Communication/Attitudes
Klein et al. (2010)[5] Germany	Physicians in surgery working in > 100 beds general hospitals with a general surgical and/or gynecological ward. Stratified probability sample based on hospital beds. Response rates: Hospital level: 53% Physician level: 36% Physicians in participating hospitals: 65%	n = 1,311 physicians Mean yrs practicing: 11 yrs Male: 60% Female: 40% Mean age = 45 ± 8.5 yrs	Copenhagen Burnout Inventory (CBI). Three scales assessing personal, client, and work burnout. This study focused on personal burnout (i.e., degree of physical and psychological fatigue and exhaustion).	Physician report: Perceived quality of care assessed using short version of Chirurgisches Qualitässiegel. Created three sub−scales: (1) psychosocial care, (2) diagnosis/therapy, (3) quality assurance. 5−point Likert scale from 1 = "very good" to 5 = "bad". Two questions about frequency of diagnostic and therapeutic errors: "I have made mistakes in diagnosis." and "I have made mistakes in treatment." 4−point Likert scale ("never" to "often"). Psychometric properties not tested for either set of questions.	Adjusted* Odds Ratios (95% CI) for probability of error and high burnout score: • Diagnostic error: 1.66 (1.26, 2.20) • Therapeutic error: 1.94 (1.39, 2.69) *Adjusted for gender, occupational position, job experience	Adjusted* Odds Ratios (95% CI) for probability of suboptimal care and high burnout score: • Psychosocial care = 1.58 (1.19, 2.10) • Dx/Tx = 1.59 (1.17, 2.16) • Quality assurance = 1.45 (1.10, 1.90) *Adjusted for gender, occupational position, job experience	
Rabatin et al. (2016)[29] USA	Primary care physicians in New York City, Chicago, and rural and urban Wisconsin Recruited 1−6 patients/physician with diabetes, hypertension or congestive heart failure Response rate: Physicians: 59.6% Nonparticipants did not differ from participants in specialty, age, or sex	n = 119 practices n = 449 physicians n = 1,419 patient charts Physician characteristics: Male: n = 235 Female: n = 187 Mean age: 43 ± 10yrs Specialties: Family Medicine: 47% General Internal Medicine: 50% Patient characteristics: Not reported	Single item measure: "Using your own definition of burnout… (a) I have no symptoms of burnout; (b) Occasionally I am under stress… but I don't feel burned out; (c) I am definitely burning out and have one or more symptoms of burnout, such as physical and emotional exhaustion; (d) The symptoms of burnout that I'm experiencing won't go away…; (e) I feel completely burned out and often wonder if I can go on…" The question correlates with the Emotional Exhaustion dimension of Maslach Burnout Inventory.[40]	Patient chart: Chart audit using a standardized template to retrospectively assess over 18−months for guideline adherence, responsiveness to "recurrent abnormalities" and missed drug interactions. Reliability not reported.	Statistics not reported No statistically significant differences between physicians with burnout and without.		

Author(s)	Study Population	Description of Sample	Burnout Measure	Quality of Care Measure	Quality of Care Outcomes		
					Medical Errors (ME)	Patient Satisfaction (PS)/Quality of Care (QoC)	Communication/Attitudes
Ratanawongsa et al. (2008)[33] USA	Physicians from 15 urban community−based clinics who provided primary care to adult patient enrolled in a randomized controlled trial for hypertensize minority patients. Response rate: Not reported	n = 40 physicians Mean years of practice: 11 ± 7.7 yrs Male: 47% Female: 53% Mean age: 42 ± 8.7 yrs Specialties: Internal Medicine: 83% Family Practice: 15% General Practice: 2% n = 235 patients Male: 34% Female: 66% Mean age: 59 ± 13.2 yrs	A 6−item scale derived from the Maslach Burnout Inventory that captures the domains of EE and PA. Five point Likert scale from 1 = "strongly agree" to 3 = "neutral" to 5 = "strongly agree". Based on terciles, burnout scores were categorized as low, average, high.	Physician report: Physicians completed "brief questionnaires indicating the degree to which they knew the patient, their attitudes toward the patient in general, and their attitudes regarding the visit". Audiotaped encounters analyzed for rapport−building communication behaviors using the Roter Interaction Analysis System. Four types of rapport identified: (1) Positive, (2) Negative, (3) Emotional, (4) Social Reliability and predictive validity tested.[41]		Adjusted* Odds Ratios (95% CI) for probability of PS with high vs low burnout: • PS = 0.44 (0.18, 1.08), p=0.07 *Adjusted for patient health insurance, visit length, physician gender, physician IMG status, interaction btwn IMG status and burnout	Odds Ratios (95% CI) for probability of negative rapport building with medium and high vs low burnout: • Medium: 1.85 (1.31, 2.61), p=0.001 • High: 2.06 (1.58, 2.86), p<0.001 *Adjusted for patient health insurance, visit length, physician gender, physician IMG status, interaction btwn IMG status and burnout

Author(s)	Study Population	Description of Sample	Burnout Measure	Quality of Care Measure	Quality of Care Outcomes		
					Medical Errors (ME)	Patient Satisfaction (PS)/Quality of Care (QoC)	Communication/Attitudes
Shanafelt et al. (2010)[42] USA	American surgeons who were members of the American College of Surgeons who permitted email correspondence. Response rate: 32%	n = 7,905 physicians Specialties: General: 41% Cardiothoracic: 6% Colorectal: 4% Otolaryngology: 5% Obstetrics/gynecology: 1% Oncologic: 5% Pediatric: 2% Plastic: 4% Transplant: 2% Trauma: 4% Urologic: 4% Vascular: 6% Other: 6% Male: 87% Female: 13% Median age (IQR): 51 yrs (43, 59)	22−item Maslach Burnout Inventory− Human Services Survey	Physician report: Response to: "Are you concerned you have made any major medical error in the last 3 months?" Psychometric properties not tested.	Odds Ratios (95% CI) for perceived medical error with MBI dimensions: • EE = 1.048 (1.042, 1.055), p<0.0001 • DP = 1.109 (1.096, 1.122), p<0.0001 • PA = 0.965 (0.955, 0.975), p<0.0001		
Shirom et al. (2006)[43] Israel	Physicians from 4 health plans specializing in either: ophthalmology, dermatology, otolaryngology, gynecology (community−based), general surgery, cardiology (hospital−based). 50% random probability sample drawn from each specialty. Response rate: 63%	n = 890 physicians Male: 80% Female: 20% Median age: 52 yrs	12−items from the Shirom−Melamed Burnout Measure with 3 sub−scales: (1) physical fatigue, (2) cognitive weariness, (3) emotional exhaustion	Physician report: Physicians completed a 15−item version of the modified SERVQUAL. 5−point Likert scale from 1 = "to a very small extent" to 5 = "to a very large extent". Psychometric properties of the modified version not tested.		Structural equation model examining relationships of autonomy, burnout and QoC: • Relationship btwn global burnout and QoC not significant (β = −0.12, p>0.05) • EE exhaustion negatively related to QoC (β = −40, p<0.05)	

Author(s)	Study Population	Description of Sample	Burnout Measure	Quality of Care Measure	Quality of Care Outcomes		
					Medical Errors (ME)	Patient Satisfaction (PS)/Quality of Care (QoC)	Communication/Attitudes
Travado et al. (2005)[34] Italy, Spain, Portugal	Physicians recruited from cancer centers of three hospitals – two general hospitals with a cancer ward and one cancer hospital. Convenience sample Response rate: Not reported	n = 125 physicians Yrs of practice: 15 ± 9.4 yrs Male: 47% Female: 54% Mean age: 42 ± 9.7 yrs	22−item Maslach Burnout Inventory− Human Services Survey Used Maslach and Jackson[6] cutoff scores for no/low burnout, intermediate, and high burnout.	Physician report: Communication skills assessed using two scales: (1) Self−Confidence in Communications Skills (SCSS). 12−item scale rating ability to communicate and manage a series of clinical situations. (2) Expected Outcomes of Communication (EOC). 23−item scale assessing extent to which physician perceives result of communication is positive or negative. Psychometric testing not completed.[44]			Correlations btwn MBI burnout dimensions and communication: Self−Confidence in Communication Skills • EE: r = −0.03, not significant • DP: r = −0.08, not significant • PA: r = 0.37, p<0.01 Negative Expected Outcomes of Communication • EE: r = −0.21, p<0.05 • DP: r = −0.25, p<0.01 • PA: r = 0.28, p<0.01 Positive Expected Outcomes of Communication • EE: r = 0.01, not significant • DP: r = 0.34, p<0.01 • PA: r = −0.28, p<0.01
Weigl et al. (2015)[45] Germany	Physicians working in one academic children's hospital who were providing patient care. Response rate: 74%	n = 88 physicians Yrs of practice: 8 ± 6.7 yrs Male: 47% Female: 53% Mean age: 37 ± 8.6 yrs	Two sub−scales of the German version of the Maslach Burnout Inventory−D: Emotional Exhaustion and Depersonalization. High burnout defined as Mean EE score > 3.5 and Mean DP > 2.5	Physician report: 2−item perceived quality of care measure: "My workload frequently leads to reduced quality of work" and "Adverse work conditions frequently lead to a loss of quality." 5−point Likert scale from 1 = "not at all" to 5 = "a very great extent". Psychometric properties not tested for the two items taken from the German version of the MBI.		Adjusted* Odds Ratios (95% CI) for probability of low QoC with MBI dimensions (Low vs High): • EE = 0.75 (0.08, 1.42), p<0.05 • DP = 0.17 (−0.45, 0.80), not significant *Adjusted for gender, professional tenure, clinical work environment, career stage/position	

Author(s)	Study Population	Description of Sample	Burnout Measure	Quality of Care Measure	Quality of Care Outcomes		
					Medical Errors (ME)	Patient Satisfaction (PS)/Quality of Care (QoC)	Communication/Attitudes
Wen et al. (2016)[46] China	Physicians practicing in one of 46 hospitals in 10 provinces n = 12 tertiary hospitals n = 9 secondary hospitals n = 25 primary hospitals In the secondary and tertiary hospitals, physicians were selected from ≥ 10 clinical departments with > 10 people in the age groups: < 30 yrs, 30−39 yrs, 40−49 yrs, ≥ 50 yrs Response rate: 89%	n = 1,607 total physicians n = 192 physicians from primary hospitals n = 354 physicians from secondary hospitals n = 991 physicians from tertiary hospitals Primary hospital Male: 54% Female: 46% Mean age: 37 ± 9.9 yrs Education: ≤ high school: 17% Some college: 47% Bachelors' degree: 35% ≥ Master's degree: 1.0% Secondary hospital Male: 53% Female: 47% Mean age: 36 ± 9.4 yrs Education: ≤ high school: 4% Some college: 17% Bachelors' degree: 73% ≥ Master's degree: 6% Tertiary hospital Male: 61% Female: 39% Mean age: 36 ± 8.0 yrs	Used 15−item Chinese version of the Maslach Burnout Inventory−General Survey Respondents grouped into three categories: (1) No burnout symptoms (2) Some burnout symptoms (3) Serious burnout symptoms	Physician report: Physicians were asked if they had made any of the following medical errors: (1) patient was harmed, (2) medication error, (3) treatment delayed, (4) incomplete or incorrect item in the patient record. Psychometric properties not tested.	Adjusted* Odds Ratios (95% CI) for probability of any medical error with no burnout symptoms group as reference: • Some burnout symptoms: 1.46 (1.13, 1.89) • Serious burnout symptoms: 2.28 (1.63, 3.17) *Adjusted for sex, workload, and hospital type		

Author(s)	Study Population	Description of Sample	Burnout Measure	Quality of Care Measure	Quality of Care Outcomes		
					Medical Errors (ME)	Patient Satisfaction (PS)/Quality of Care (QoC)	Communication/Attitudes
		Education: ≤ high school: 1% Some college: 3% Bachelors' degree: 46% ≥ Master's degree: 51%					
Weng et al. (2011)[35] Taiwan	Physicians working in two hospitals. Patients of participating physicians. Physician response rate: Not reported Patient response rate: 78%	n = 110 internists Male: 85% Female: 15% Mean age: 41 ± 6.9 yrs n = 2,872 patients Male: 59% Female: 41%	Maslach Burnout Inventory−Human Services Survey	Patient report: Patient satisfaction assessed with two questions: "I am satisfied with the care provided by my doctor" and "I would recommend this doctor to my friends and family members". Single item from the CSQ's[36] General Satisfaction sub−scale not validated for individual use. Single item about recommendation was correlated with EUROPEP patient satisfaction questionnaire.[47]		Correlation btwn MBI burnout dimensions and PS: • EE: not significant • DP: negative relationship ($p<0.01$) • PA: not significant	

Description of the Study Populations

Six of the studies focused on hospital-based physicians.[5,30,34,35,45,46] Among these studies, two focused on cancer[34] and children's[45] specialty hospitals. In addition, one of these studies recruited surgeons practicing either in general surgery or gynecological wards.[5] One of these studies[46] also included people practicing as physicians who did not have graduate educations.

The remaining five studies recruited physicians practicing in a variety of settings. Three studies sought physicians in primary health care centers;[29,31,33] they included physicians practicing in internal medicine, general practice, and family practice. One of the studies[29] that recruited primary care physicians focused on the quality of care only for patients with diabetes and/or hypertension.

Two studies did not specify the setting.[32,42] However, of these two, one focused on surgeons.[42] Finally, one study used four health plans to recruit and contained a mixture of community and hospital physicians[43] which included physicians specializing in ophthalmology, dermatology, otolaryngology, community-based gynecology, general surgery, and hospital-based cardiology.

Measuring Burnout

In nine of the 12 studies, burnout was measured using either the 22-item Maslach Burnout Inventory (MBI),[6] translated version of the MBI-GS,[46] translated version of the MBI-HS[30,31] or selected MBI sub-scales.[30-35,42,45,46] The complete 22-item MBI measures three dimensions of burnout: Emotional Exhaustion, Depersonalization and Personal Accomplishment. It is one of the most widely used measures of burnout in the scientific literature.[48,49] One study[29] used a single item measure for burnout that correlates with the Emotional Exhaustion sub-scale of the MBI.[40]

The two remaining studies used the Copenhagen Burnout Inventory (CBI)[48] and the Shirom-Melamed Burnout Measure (SMBM).[49,50] The CBI is a 19-item scale comprised of three sub-scales that assess personal burnout, work-related burnout, and client-related burnout.[48] It has been shown to be correlated with mental and general health as well as job satisfaction.[48] The SMBM is a 22-item measure with three sub-scales that assess physical fatigue, emotional exhaustion, and cognitive weariness.[49] The psychometric properties of these scales continue to be explored.[49,51,52]

Measuring Quality of Care related to Acceptability and Patient Safety

Four types of quality of care measures related to acceptability and safety were used in these studies. In terms of patient safety, medical errors were measured. Acceptability related measures included patient satisfaction, perceived general quality of care, and physician communication/attitudes.

Patient Safety Measures: Medical errors

Patient safety was examined with medical errors. This outcome was assessed in five studies.[5,29,30,42,46] Wen et al.[46] asked respondents whether they had made any medical errors including one that resulted in a patient being harmed, a medication error, delay in treatment, or incomplete or incorrect item being added to the patient record. Hayashino et al.[30] and Shanafelt et al.[42] used similar questions about whether the respondent made major medical errors. However, the studies differed in the time frame that the respondent was asked to consider. Hayashino et al.[30] asked about the past year while Shanafelt et al.[42] inquired about the past three months. In contrast to these studies, Klein et al.[5] asked about frequency of diagnostic mistakes and treatment without specifying a time frame. The studies differ in the types of errors that they asked about (i.e., *major* errors rather than *any* errors). In addition, they depend on recall and

self-report. Shanafelt et al.[42] note that studies have used this type of question to gather information about medical errors. However, there are also studies that have found that physicians under-report medical errors.[53] Furthermore, there is evidence that physicians have a limited ability to self-assess their practice patterns.[54]

In addition to questions about frequency of diagnostic mistakes and treatment, Klein et al.[5] included a questionnaire based on the Canadian Physician Achievement Review to evaluate physician self-perceived quality of psychosocial care, diagnosis/therapy, and quality assurance.[55] However, the authors note that additional work regarding its validity is warranted.[5]

There was only one study that did not rely on self-report to gather information about medical errors. Rabatin et al.[29] used a chart audit to assess medical errors characterized by adherence to guidelines, responsiveness to "recurrent abnormalities" and missed drug interactions.

Acceptability Measures: Patient satisfaction/Perceived Quality of Care

With regard to acceptability measures, patient satisfaction was assessed in four studies.[31,32,35,43] In two of these studies, the SERVQUAL was used to measure patient satisfaction/quality of care.[32,43] The SERVQUAL was developed to measure service quality along five dimensions: (1) tangibles (i.e., physical facilities), (2) reliability (i.e., performs dependably and accurately), (3) responsiveness (i.e., willingness to help), (4) assurance (i.e., ability to inspire trust), and (5) empathy (i.e., caring).[56] Halbesleben and Rathert[32] used a healthcare specific version of the SERVQUAL. The psychometric properties of the scale were examined.[38] However, Asubonteng et al.[39] have raised questions about the strength of the scale's psychometric properties.

Shirom and colleagues[43] adapted the SERVQUAL by eliminating seven items and revising the language for physicians to rate their own quality of care using the remaining 15 items. The validity of this modified measure was not examined.

Weigl et al.[45] looked at physician-perceived quality of care by asking physicians to rate two statements on a 5-point scale, "My workload frequently leads to reduced quality of work," and "Adverse work conditions frequently lead to a loss of quality." The authors reference the German version of the MBI as the source for these questions. However, they do not provide information about the psychometric properties of the individual use of these items.

One study[31] used the Consultation Satisfaction Questionnaire (CSQ) scale that was created and validated to assess patient satisfaction with general practitioners.[36] It is comprised of 18 items and measures satisfaction along four dimensions: general satisfaction, professional care, depth of relationship, and perceived time.

Finally, in their study, Weng et al.[35] used two questions to indicate patient satisfaction, "I am satisfied with the care provided by my doctor," and "I would recommend this doctor to my friends and family." The first of Weng et al.'s[35] question is similar to one of the CSQ's[36] general satisfaction items, "I am totally satisfied with my visit to the doctor." However, the use of this single-item has not been validated. A version of the second question has been used to measure satisfaction and was correlated with the EUROPEP patient satisfaction questionnaire.[47]

Acceptability Measures: Communication/Attitudes

Two studies focused on physician communication/attitudes.[33,34] Using audiotapes of physician/patient interactions, Ratanawongsa et al.[33] assessed the interactions by employing the Roter Interaction Analysis System (RIAS).[57] RIAS is a validated method of categorizing these interactions into three categories related either to content, affection, or process.[58] There is

evidence that there is an association between the content and the socioemotional nature of the interactions as categorized using the RIAS and patient satisfaction.[57,58]

Travado et al.[34] examined the association between burnout and communication using two measures: the Self-Confidence in Communications Skills (SCSS) and the Expected Outcomes of Communication (EOC).[44] In their article, Parle and colleagues[44] note that exploration of the psychometric properties of both measures were being conducted but were not yet completed. Both were developed to understand the communication skills of physicians working with cancer patients.

Study Outcomes: Burnout and Quality of Care

In this sub-section, we report about the quality of care outcomes from the included studies (Table 1). This review of outcomes begins by describing the findings regarding the association between burnout and patient safety (i.e., medical errors). It is followed by reporting of the acceptability outcomes as measured by patient satisfaction/perceived quality of care and physician communication/attitudes.

Outcomes: Burnout and Medical Errors

Table 1 contains the outcomes reported by the included papers. In terms of findings for the association between burnout and medical errors, there was a consistently significant relationship between burnout and medical errors among four papers focusing on this relationship.[5,30,42,46] Shanafelt et al.[42] reported significantly higher odds of a major medical error during the past three months among physicians with higher EE and DP but lower odds among physicians with higher PA. Hayashino et al.[30] also observed significant associations between a major medical error during the past 12 months and higher levels of EE and DP; however, the relationship with PA was not significant. Klein et al.[5] reported significant associations between

high burnout and diagnostic error, therapeutic error, sub-optimal psychosocial care, sub-optimal diagnosis and treatment, and sub-optimal quality assurance. Wen et al.[46] found higher odds of medical errors among physicians with either some or serious burnout symptoms as opposed to no burnout symptoms.

The one paper[29] that assessed errors based on chart audits did not find a significant relationship between burnout and medical errors. But, it should be noted that this study focused on treatment for a sub-group of patients with chronic disorders that included diabetes and/or hypertension.

Outcomes: Burnout and Patient Satisfaction/Quality of Care

Among the four studies that examined the relationship between burnout and patient satisfaction/quality of care, three observed a significant relationship between either burnout or at least one dimension of burnout.[31-33,35] The one study[33] that combined the MBI EE and PA dimensions to create a single burnout score did not find a significant relationship between the score and patient satisfaction. Because it used only two sub-scales and one of them was PA rather than DP, it is not clear regarding the extent to which their choice of sub-scales was consistent with the other measures of burnout.

Among the three studies that reported separate MBI dimensions, there seemed to be a consistent observation that high DP is significantly related to lower patient satisfaction.[31,32,35] However, the significance of the association between EE and patient satisfaction varied among studies; Anagnostopoulos et al.[31] reported a significant correlation but Weng et al.[35] did not.

At the same time, Shirom et al.[43] described a significantly negative relationship between high EE and physician perceived quality of care. Weigl and colleagues[45] also found a significant

negative relationship with EE but did not find a significant relationship between DP and physician perceived quality of care.

Outcomes: Burnout and Communication/Attitudes

Travado et al.[34] found a significantly positive relationship between PA and self-confidence in communication skills as well as with negative expected outcomes of communication. They also observed a significantly negative association between PA and positive expected outcomes of communication. In addition, Ratanawongsa et al.[33] reported a higher probability of negative rapport with medium and high burnout.

DISCUSSION

This systematic literature review identified 12 studies of which 10 had a moderate risk of bias and two had a high risk of bias. The results of these physician burnout studies show that patient safety has been primarily measured by examining medical errors. The acceptability outcomes have been captured using two groups of indicators that measure patient satisfaction/perceived quality of care and physician communication/attitudes towards patients. The majority of these studies examined the relationship between burnout and acceptability. Among the acceptability-related quality of care outcomes, the focus has been on patient satisfaction/perceived quality of care.

The results of four of the five included studies that reported on the relationship between burnout and medical errors suggest there is evidence that burnout is associated with physician self-perceived medical errors and sub-optimal care. However, there is equivocal evidence that specific dimensions of burnout are related to the acceptability dimension of quality of care as measured by patient satisfaction, perceived quality of care, or physician communication/attitudes. Thus, the current body of evidence suggests there is moderate

evidence for the association between burnout and safety aspects of healthcare whereas the evidence is weaker for the patient-related acceptability aspects of quality.

Strengths and Limitations of Interpreting the Literature

One of the important questions raised by burnout studies in general is highlighted by Klein et al.'s[5] and Shirom et al.'s[43] use of non-MBI scales. Klein and colleagues[5] used the Copenhagen Burnout Inventory while Shirom et al.[43] used the Shirom-Melamed Burnout Measure. One of the criticisms that the separate developers of these two scales raise is that the MBI does not fully assess burnout.[43,48] Rather, both groups argue that fatigue and exhaustion are fundamental to the definition of burnout.[43,48] However, this emphasis on exhaustion may be reflected in the fact that EE is the most widely studied of the MBI dimensions.[59] This would argue for the assessment of this dimension in studies of burnout and the individual reporting of it.

Another limitation of these studies was the reliance on physician self-report data for the assessment of medical errors. The self-report could be influenced by a number of factors including recall bias and social desirability. There is a potential additional bias introduced if self-report is used for both the outcome and the problem.[60] The presence of burnout could also influence perceptions. For example, Fahrenkopf et al.[61] observed a discrepancy between the results of chart audits and physician self-report; those with higher burnout scores reported higher numbers of medical errors than the chart audits would suggest.

An alternative to self-report would be observational data. However, watching physicians while they practice could lead to a Hawthorne Effect. Another alternative would be to review medical records to identify errors. But, this relies on the accuracy of the records. Also, it is not clear what types of medical errors should be assessed – major errors leading to an adverse event

or any medical error regardless of outcome? In their study, Fahrenkopf et al.[61] used a standardized method to abstract information from charts and trained reviewers to categorize the errors into groups: (1) preventable adverse event, (2) non-preventable adverse event, (3) potential adverse event, and (4) error with little potential for harm. Further work could examine how physicians define errors as well as the reliability of error self-report. In addition, to improve the comparability of outcomes, future studies could incorporate and report severity of medical error scores.

There was a diverse set of measures used in the studies that focused on patient satisfaction and quality of care. They varied in what and how they measured the outcome. In addition, the majority of the studies did not use validated outcome measures. For example, perceived quality of care was assessed using a variety of measures that ranged from two items for which the psychometric properties were not tested to a scale designed to assess service quality on six dimensions. Thus, it is difficult to discern the extent to which the study results could be attributed to the differences in the dimensions assessed. Further exploration along this line of inquiry could be undertaken to understand the aspects of satisfaction and perceived quality of care that are significantly associated with burnout.

An additional limitation of the existing body of literature is the reliance on cross-sectional study designs. Cross-sectional design limits conclusions regarding causality. Cross-sectional data does not distinguish the sequence of conditions. For example, did burnout cause decreased quality of care? Or, did decreased quality of care cause burnout? At best, the cross-sectional data used in these studies can only be used to determine that there is a relationship. At that same time, there is evidence from studies that have used longitudinal data to examine burnout and medical errors among residents that there is a causal relationship such that burnout

causes errors.[62] However, the longitudinal data that contributes to the strength of West et al.'s [62] is potentially weakened by the self-reported medical errors.

Finally, only two studies[5,29] described the population from which the study sample was drawn. Thus, it is difficult to determine whether there was a difference between the study participants and non-participants. To aid in the interpretation of the results (i.e., the generalizability), it would be useful for future studies to report this type of information.

Strengths and Limitations of the Search Strategy

Although six databases were used in the search, articles that did not appear in any of the databases would have been missed. To decrease the possibility of this occurring, we employed a broad scope in development of the search terms for each database and followed this with a hand search of included articles. Another potential limitation is the fact that the search focused on articles published in English-language journals. However, despite the English-language constraint, the identified studies originated in European, Middle Eastern, North American and Asian countries. This indicates that although the research was not conducted in countries where English is the first language, at least some of these researchers publish in English-language journals. Finally, there is also a potential limitation associated with focusing on published peer-reviewed articles. In doing so, we may be subject to publication bias.[63] At the same time, the quality of the gray literature has been questioned because it is not necessarily subject to critical assessment prior to being published.[64] As a result, unpublished studies may be of lower quality and have greater risk of bias in their study designs.

CONCLUSIONS

The focus on quality related to direct care can highlight additional ways that physician burnout affects the healthcare system. These results contribute evidence about whether the effects of physician burnout are limited to physicians or whether consequences of physician burnout are more extensive. They also can help to inform decisions about how to improve patient care by addressing physician burnout. That is, decisions can be informed when confronting a question of how to improve quality of patient care. There are a number of ways in which this may be done through investment in capital such as new technologies. The results of this systematic review suggest that an alternative investment could be in human resources as represented by physician staff.

The results of this systematic literature review suggest that there is moderate evidence that burnout is associated with safety-related quality of care. Because of the variability in the way patient acceptability-related quality of care was measured and the inconsistency in study findings, the evidence supporting the relationship between burnout and patient acceptability-related quality of care is less strong. Future research evaluating burnout interventions for physicians could consider looking at safety-related quality of care to assess the effectiveness of these interventions. Continued work looking at the relationship between dimensions of acceptability-related quality of measures and burnout is warranted.

DATA SHARING STATEMENT

All the published papers used in this manuscript are publicly available. There are no data available.

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COMPETING INTERESTS

The authors declare that they have no competing interests.

CONTRIBUTORSHIP STATEMENT

CSD led the conception, design, data acquisition, analysis and interpretation of the data; she also led the writing of the overall manuscript. DL collaborated on the design, data acquisition and analysis; he contributed to the writing of the overall manuscript and led the writing of the Methods section. SB collaborated on the design and data acquisition and contributed to the writing of the manuscript. LT collaborated on the data acquisition and analysis. All authors read and approved the final manuscript. All authors are guarantors of the final manuscript.

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FIGURES, TABLES AND SUPPLEMENTARY FILES LEGEND

Figure 1. Flowchart of Accepted/ Rejected Articles

Figure 2. Summary of Risk of Bias Across Studies

Table 1. Study Descriptions and Reported Patient Safety and Acceptability Related Quality of Care Outcomes

Supplementary File 1: PRISMA Checklist

Supplementary File 2: Search Terms Used in Search Strategy

Supplementary File 3: Risk of Bias Assessment Checklist

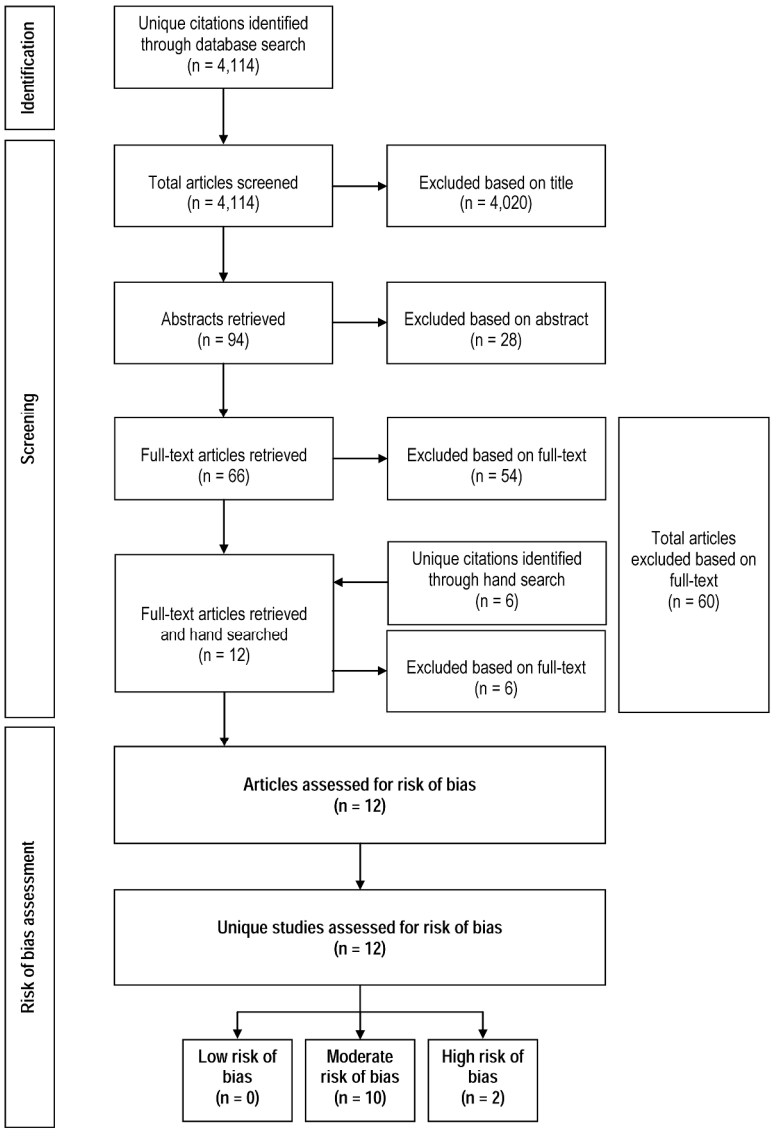

Figure 1. Flowchart of Accepted/ Rejected Articles

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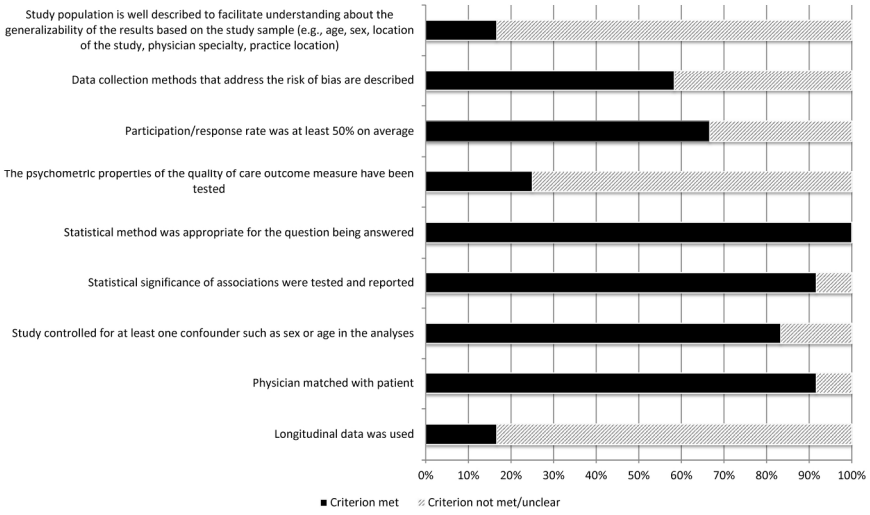

Figure 2. Summary of Risk of Bias Across Studies

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PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	4-5
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4-5
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	N/A
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	7-10
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	7
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	7-11 Supp. File 1
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	9-11
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	N/A
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	9-11
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	10-11
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	N/A
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	N/A

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	10-11
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	N/A
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	11, Fig. 1
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	12-25, Table 1
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	11-12, Supp. File 2
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	25-27, Table 1
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	N/A
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	11-12, Fig. 2
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	N/A
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	27-28
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	28-30
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	31
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	32

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit: www.prisma-statement.org.

Search terms used in search strategy

Database	Search Terms
Medline Current	[exp Burnout, Professional/ OR burnout.mp. OR (burnout adj3 effect$).mp.] AND [exp Physicians/ OR exp Psychiatry/ OR allergist$.mp. OR anesthesiologist$.mp. OR cardiologist$.mp. OR clinical pharmacologist$.mp. OR clinical toxicologist$.mp. OR dermatologist$.mp. OR doctor$.mp. OR endocrinologist$.mp. OR gastroenterologist$.mp. OR gynecologist$.mp. OR hematologist$.mp. OR immunologist$.mp. OR medical biochemist$.mp. OR medical geneticist$.mp. OR medical microbiologist$.mp. OR nephrologist$.mp. OR neurologist$.mp. OR neuropathologist$.mp. OR neuroradiologist$.mp. OR occupational physician$.mp. OR oncologist$.mp. OR ophthalmologist$.mp. OR pathologist$.mp. OR pediatrician$.mp. OR physician$.mp. OR psychiatrist$.mp. OR radiologist$.mp. OR rheumatologist$.mp. OR surgeon$.mp. OR urologist$.mp.] AND [exp Diagnostic Errors/ OR exp Medical Errors/ OR exp Medication Errors/ OR exp "Quality of Health Care"/ OR exp Quality Assurance, Health Care/ OR misdiag$.mp. OR (diagnos$ adj3 error$).mp. OR (medical$ adj3 error$).mp. OR (medication$ adj3 error$).mp. OR (drug$ adj3 error$).mp. OR (mistak$ adj3 medic$).mp. OR (surgic$ adj3 error$).mp. OR (quality$ adj3 health$ adj3 care$).mp. OR (quality$ adj3 healthcare$).mp. OR (quality$ adj3 of adj3 care$).mp. OR exp Professional Competence/ OR (professional$ adj3 competenc$).mp. OR (technical$ adj3 expertise$).mp. OR (expertise$ adj3 generaliz$).mp. OR professionalism$.mp. OR exp Treatment Outcome/ OR (treat$ adj3 outcome$).mp. OR (patient$ adj3 outcome$).mp. OR exp Professional Impairment/ OR (impair$ adj3 physician$).mp. OR (impair$ adj3 doctor$).mp. OR (disruptive$ adj3 behav$).mp. OR exp Safety/ OR safe$.mp. OR exp Risk/ OR risk$.mp. OR exp Patient Satisfaction/ OR (patient$ adj3 satisf$).mp. OR (client$ adj3 satisf$).mp. OR exp Professional-Patient Relations/ OR (professional$ adj3 patient$ adj3 relation$).mp. OR (client$ adj3 contact$).mp. OR exp Physician-Patient Relations/ OR (physician$ adj3 patient$ adj3 relation$).mp. OR (doctor$ adj3 patient$ adj3 relation$).mp. OR exp Communication/ OR communicat$.mp. OR misinform$.mp. OR exp Health Communication/ OR exp "Attitude of Health Personnel"/ OR attitude$.mp. OR exp Clinical Competence/ OR (clinical$ adj3 competenc$).mp. OR (clinical$ adj3 skill$).mp. OR exp Patient-Centered Care/ OR (patient$ adj3 cent$ adj3 care$).mp. OR (patient$ adj3 focus$ adj3 care$).mp. OR exp Empathy/ OR empath$.mp. OR exp Patient Care/ OR (patient$ adj3 care$).mp. OR (informal$ adj3 care$).mp. OR exp "Standard of Care"/ OR (standard$ adj3 care$).mp. OR st.fs. [standards - floating subheading] OR exp Self Efficacy/ OR efficacy$.mp. OR exp Clinical Audit/ OR audit$.mp. OR exp Medical Audit/ OR (diagnos$ adj3 mistak$).mp. OR (medication$ adj3 mistak$).mp. OR (drug$ adj3 mistak$).mp. OR (surgic$ adj3 mistak$).mp. OR exp Safety Management/ OR (program$ adj3 hazard$ adj3 surveillance$).mp. OR (management$ adj3 safety$).mp. OR (hazard$ adj3 control$).mp. OR (hazard$ adj3 management$).mp. OR exp Malpractice/ OR malpractic$.mp. OR negligen$.mp. OR exp Morbidity/ OR morbidit$.mp. OR exp Postoperative Complications/ OR (postoperative$ adj3 complication$).mp. OR exp Cross Infection/ OR (nosocomial$ adj3 infection$).mp. OR (hospital$ adj3 infection$).mp. OR (cross$ adj3 infection$).mp. OR exp Physician's Practice Patterns/ OR (practice$ adj3 pattern$ adj3 clinical$).mp. OR (practice$ adj3 pattern$ adj3 physician$).mp. OR (prescribing$ adj3 pattern$ adj3 physician$).mp. OR (practice$ adj3 pattern$ adj3 professional$).mp. OR (practice$ adj3 pattern$ adj3 variation$).mp. OR (practice$ adj3 clinical$ adj3 variation$).mp. OR (practice$ adj3 medical$ adj3 variation$).mp. OR exp Mortality/ OR (rate$ adj3 age-specific$ adj3 death$).mp. OR (rate$ adj3 death$).mp. OR (rate$ adj3 fatalit$).mp. OR mortalit$.mp. OR exp "Outcome Assessment (Health Care)"/ OR (measure$ adj3 outcome$).mp. OR (assessment$ adj3 outcome$).mp. OR (research$ adj3 outcome$).mp. OR (stud$ adj3 outcome$).mp. OR (assessment$ adj3 patient$ adj3 outcome$).mp. OR (research$ adj3 patient$ adj3 outcome$).mp. OR exp Risk Reduction Behavior/ OR exp Risk-Taking/ OR exp "Root Cause Analysis"/ OR (cause$ adj3 root$ adj3 analys$).mp. OR exp "Drug-Related Side Effects and Adverse Reactions"/ OR (drug$ adj3 side$ adj3 effect$).mp. OR (drug$ adj3 toxic$).mp. OR (drug$ adj3 reaction$ adj3 adverse$).mp. OR (drug$ adj3 event$ adj3 adverse$).mp. OR ae.fs. [adverse effects floating subheading] OR mo.fs. [mortality floating subheading] OR po.fs. [poisoning floating subheading] OR to.fs. [toxicity floating subheading] OR in.fs. [injuries floating subheading]]
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Database	Search Terms
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Medline Epub Ahead of Print	[exp Burnout, Professional/ OR burnout.mp. OR (burnout adj3 effect$).mp.] AND [exp Physicians/ OR exp Psychiatry/ OR allergist$.mp. OR anesthesiologist$.mp. OR cardiologist$.mp. OR clinical pharmacologist$.mp. OR clinical toxicologist$.mp. OR dermatologist$.mp. OR doctor$.mp. OR endocrinologist$.mp. OR gastroenterologist$.mp. OR gynecologist$.mp. OR hematologist$.mp. OR immunologist$.mp. OR medical biochemist$.mp. OR medical geneticist$.mp. OR medical microbiologist$.mp. OR nephrologist$.mp. OR neurologist$.mp. OR neuropathologist$.mp. OR neuroradiologist$.mp. OR occupational physician$.mp. OR oncologist$.mp. OR ophthalmologist$.mp. OR pathologist$.mp. OR pediatrician$.mp. OR physician$.mp. OR psychiatrist$.mp. OR radiologist$.mp. OR rheumatologist$.mp. OR surgeon$.mp. OR urologist$.mp.] AND [exp Diagnostic Errors/ OR exp Medical Errors/ OR exp Medication Errors/ OR exp "Quality of Health Care"/ OR exp Quality Assurance, Health Care/ OR misdiag$.mp. OR (diagnos$ adj3 error$).mp. OR (medical$ adj3 error$).mp. OR (medication$ adj3 error$).mp. OR (drug$ adj3 error$).mp. OR (mistak$ adj3 medic$).mp. OR (surgic$ adj3 error$).mp. OR (quality$ adj3 health$ adj3 care$).mp. OR (quality$ adj3 healthcare$).mp. OR (quality$ adj3 of adj3 care$).mp. OR exp Professional Competence/ OR (professional$ adj3 competenc$).mp. OR (technical$ adj3 expertise$).mp. OR (expertise$ adj3 generaliz$).mp. OR professionalism$.mp. OR exp Treatment Outcome/ OR (treat$ adj3 outcome$).mp. OR (patient$ adj3 outcome$).mp. OR exp Professional Impairment/ OR (impair$ adj3 physician$).mp. OR (impair$ adj3 doctor$).mp. OR (disruptive$ adj3 behav$).mp. OR exp Safety/ OR safe$.mp. OR exp Risk/ OR risk$.mp. OR exp Patient Satisfaction/ OR (patient$ adj3 satisf$).mp. OR (client$ adj3 satisf$).mp. OR exp Professional-Patient Relations/ OR (professional$ adj3 patient$ adj3 relation$).mp. OR (client$ adj3 contact$).mp. OR exp Physician-Patient Relations/ OR (physician$ adj3 patient$ adj3 relation$).mp. OR (doctor$ adj3 patient$ adj3 relation$).mp. OR exp Communication/ OR communicat$.mp. OR misinform$.mp. OR exp Health Communication/ OR exp "Attitude of Health Personnel"/ OR attitude$.mp. OR exp Clinical Competence/ OR (clinical$ adj3 competenc$).mp. OR (clinical$ adj3 skill$).mp. OR exp Patient-Centered Care/ OR (patient$ adj3 cent$ adj3 care$).mp. OR (patient$ adj3 focus$ adj3 care$).mp. OR exp Empathy/ OR empath$.mp. OR exp Patient Care/ OR (patient$ adj3 care$).mp. OR (informal$ adj3 care$).mp. OR exp "Standard of Care"/ OR (standard$ adj3 care$).mp. OR st.fs. [standards - floating subheading] OR exp Self Efficacy/ OR efficacy$.mp. OR exp Clinical Audit/ OR audit$.mp. OR exp Medical Audit/ OR (diagnos$ adj3 mistak$).mp. OR (medication$ adj3 mistak$).mp. OR (drug$ adj3 mistak$).mp. OR (surgic$ adj3 mistak$).mp. OR exp Safety Management/ OR (program$ adj3 hazard$ adj3 surveillance$).mp. OR (management$ adj3 safety$).mp. OR (hazard$ adj3 control$).mp. OR (hazard$ adj3 management$).mp. OR exp Malpractice/ OR malpractic$.mp. OR negligen$.mp. OR exp Morbidity/ OR morbidit$.mp. OR exp Postoperative Complications/ OR (postoperative$ adj3 complication$).mp. OR exp Cross Infection/ OR (nosocomial$ adj3 infection$).mp. OR (hospital$ adj3 infection$).mp. OR (cross$ adj3 infection$).mp. OR exp Physician's Practice Patterns/ OR (practice$ adj3 pattern$ adj3 clinical$).mp. OR (practice$ adj3 pattern$ adj3 physician$).mp. OR (prescribing$ adj3 pattern$ adj3 physician$).mp. OR (practice$ adj3 pattern$ adj3 professional$).mp. OR (practice$ adj3 pattern$ adj3 variation$).mp. OR (practice$ adj3 clinical$ adj3 variation$).mp. OR (practice$ adj3 medical$ adj3 variation$).mp. OR exp Mortality/ OR (rate$ adj3 age-specific$ adj3 death$).mp. OR (rate$ adj3 death$).mp. OR (rate$ adj3 fatalit$).mp. OR mortalit$.mp. OR exp "Outcome Assessment (Health Care)"/ OR (measure$ adj3 outcome$).mp. OR (assessment$ adj3 outcome$).mp. OR (research$ adj3 outcome$).mp. OR (stud$ adj3 outcome$).mp. OR (assessment$ adj3 patient$ adj3 outcome$).mp. OR (research$ adj3 patient$ adj3 outcome$).mp. OR exp Risk Reduction Behavior/ OR exp Risk-Taking/ OR exp "Root Cause Analysis"/ OR (cause$ adj3 root$ adj3 analys$).mp. OR exp "Drug-Related Side Effects and Adverse Reactions"/ OR (drug$ adj3 side$ adj3 effect$).mp. OR (drug$ adj3 toxic$).mp. OR (drug$ adj3 reaction$ adj3 adverse$).mp. OR (drug$ adj3 event$ adj3 adverse$).mp. OR ae.fs. [adverse effects floating subheading] OR mo.fs. [mortality floating subheading] OR po.fs. [poisoning floating subheading] OR to.fs. [toxicity floating subheading] OR in.fs. [injuries floating subheading]]

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PsycINFO	[burnout.mp. OR (burnout adj3 effect$).mp.] AND [exp physicians/ OR exp clinicians/ OR exp Psychiatry/ OR allergist$.mp. OR anesthesiologist$.mp. OR cardiologist$.mp. OR clinical pharmacologist$.mp. OR clinical toxicologist$.mp. OR dermatologist$.mp. OR doctor$.mp. OR endocrinologist$.mp. OR gastroenterologist$.mp. OR gynecologist$.mp. OR hematologist$.mp. OR immunologist$.mp. OR medical biochemist$.mp. OR medical geneticist$.mp. OR medical microbiologist$.mp. OR nephrologist$.mp. OR neurologist$.mp. OR neuropathologist$.mp. OR neuroradiologist$.mp. OR occupational physician$.mp. OR oncologist$.mp. OR ophthalmologist$.mp. OR pathologist$.mp. OR pediatrician$.mp. OR physician$.mp. OR psychiatrist$.mp. OR radiologist$.mp. OR rheumatologist$.mp. OR surgeon$.mp. OR urologist$.mp.] AND [exp Errors/ OR exp "Quality of Care"/ OR misdiag$.mp. OR (diagnos$ adj3 error$).mp. OR (medical$ adj3 error$).mp. OR (medication$ adj3 error$).mp. OR (drug$ adj3 error$).mp. OR (mistak$ adj3 medic$).mp. OR (surgic$ adj3 error$).mp. OR (quality$ adj3 health$ adj3 care$).mp. OR (quality$ adj3 healthcare$).mp. OR (quality$ adj3 of adj3 care$).mp. OR exp Professional Competence/ OR (professional$ adj3 competenc$).mp. OR (technical$ adj3 expertise$).mp. OR (expertise$ adj3 generaliz$).mp. OR professionalism$.mp. OR exp Treatment Outcome/ OR (treat$ adj3 outcome$).mp. OR (patient$ adj3 outcome$).mp. OR exp Impaired Professionals/ OR (impair$ adj3 physician$).mp. OR (impair$ adj3 doctor$).mp. OR (disruptive$ adj3 behav$).mp. OR exp Safety/ OR safe$.mp. OR exp Risk Factors/ OR exp Risk Management/ OR exp Risk Assessment/ OR risk$.mp. OR exp Client Satisfaction/ OR (patient$ adj3 satisf$).mp. OR (client$ adj3 satisf$).mp. OR exp Therapeutic Processes/ OR (professional$ adj3 patient$ adj3 relation$).mp. OR (client$ adj3 contact$).mp. OR (physician$ adj3 patient$ adj3 relation$).mp. OR (doctor$ adj3 patient$ adj3 relation$).mp. OR exp Communication/ OR communicat$.mp. OR misinform$.mp. OR exp Communication Skills/ OR exp Communication Barriers/ OR exp Health Personnel Attitudes/ OR attitude$.mp. OR exp Competence/ OR (clinical$ adj3 competenc$).mp. OR (clinical$ adj3 skill$).mp. OR exp Client Centered Therapy/ OR (patient$ adj3 cent$ adj3 care$).mp. OR (patient$ adj3 focus$ adj3 care$).mp. OR exp Empathy/ OR empath$.mp. OR exp Patients/ OR (patient$ adj3 care$).mp. OR (informal$ adj3 care$).mp. OR exp Professional Standards/ OR (standard$ adj3 care$).mp. OR exp Self Efficacy/ OR efficacy$.mp. OR exp Clinical Audits/ OR audit$.mp. OR (diagnos$ adj3 mistak$).mp. OR (medication$ adj3 mistak$).mp. OR (drug$ adj3 mistak$).mp. OR (surgic$ adj3 mistak$).mp. OR (program$ adj3 hazard$ adj3 surveillance$).mp. OR (management$ adj3 safety$).mp. OR (hazard$ adj3 control$).mp. OR (hazard$ adj3 management$).mp. OR exp Professional Liability/ OR malpractic$.mp. OR negligen$.mp. OR exp Morbidity/ OR morbidit$.mp. OR exp Postoperative Complications/ OR (postoperative$ adj3 complication$).mp. OR (nosocomial$ adj3 infection$).mp. OR (hospital$ adj3 infection$).mp. OR (cross$ adj3 infection$).mp. OR exp Clinical Practice/ OR (practice$ adj3 pattern$ adj3 clinical$).mp. OR (practice$ adj3 pattern$ adj3 physician$).mp. OR (prescribing$ adj3 pattern$ adj3 physician$).mp. OR (practice$ adj3 pattern$ adj3 professional$).mp. OR (practice$ adj3 pattern$ adj3 variation$).mp. OR (practice$ adj3 clinical$ adj3 variation$).mp. OR (practice$ adj3 medical$ adj3 variation$).mp. OR exp Mortality Rate/ OR exp "Death and Dying"/ OR (rate$ adj3 age-specific$ adj3 death$).mp. OR (rate$ adj3 death$).mp. OR (rate$ adj3 fatalit$).mp. OR mortalit$.mp. OR exp Treatment Effectiveness Evaluation/ OR (measure$ adj3 outcome$).mp. OR (assessment$ adj3 outcome$).mp. OR (research$ adj3 outcome$).mp. OR (stud$ adj3 outcome$).mp. OR (assessment$ adj3 patient$ adj3 outcome$).mp. OR (research$ adj3 patient$ adj3 outcome$).mp. OR exp Risk-Taking/ OR exp Error Analysis/ OR (cause$ adj3 root$ adj3 analys$).mp. OR exp "Side Effects (Drug)"/ OR (drug$ adj3 side$ adj3 effect$).mp. OR (drug$ adj3 toxic$).mp. OR (drug$ adj3 reaction$ adj3 adverse$).mp. OR (drug$ adj3 event$ adj3 adverse$).mp. OR exp Toxic Disorders/ OR exp Injuries/ OR 3620.cc. [Personnel Management & Selection & Training classification code] OR 3630.cc. [Personnel Evaluation & Job Performance classification code] OR 3650.cc. [Personnel Attitudes & Job Satisfaction classification code] OR 3670.cc. [Working Conditions & Industrial Safety classification code] OR 3430.cc. [Professional Personnel Attitudes & Characteristics classification code] OR 3450.cc. [Professional Ethics & Standards & Liability code] OR 3470.cc. [Impaired Professionals classification code]]
Embase	[exp Burnout/ OR burnout.mp. OR (burnout adj3 effect$).mp.] AND [exp Physicians/ OR exp Psychiatry/ OR allergist$.mp. OR anesthesiologist$.mp. OR cardiologist$.mp. OR clinical pharmacologist$.mp. OR clinical toxicologist$.mp. OR dermatologist$.mp. OR doctor$.mp. OR endocrinologist$.mp. OR gastroenterologist$.mp. OR gynecologist$.mp. OR hematologist$.mp. OR immunologist$.mp. OR medical biochemist$.mp. OR medical geneticist$.mp. OR medical microbiologist$.mp. OR nephrologist$.mp. OR neurologist$.mp. OR neuropathologist$.mp. OR neuroradiologist$.mp. OR occupational physician$.mp. OR oncologist$.mp. OR ophthalmologist$.mp. OR pathologist$.mp. OR pediatrician$.mp. OR physician$.mp. OR psychiatrist$.mp. OR radiologist$.mp. OR rheumatologist$.mp. OR surgeon$.mp. OR urologist$.mp.] AND [exp Diagnostic Errors/ OR exp Medical Errors/ OR exp Medication Errors/ OR exp Health care quality/ OR exp Quality control/ OR misdiag$.mp. OR (diagnos$ adj3 error$).mp. OR (medical$ adj3 error$).mp. OR (medication$ adj3 error$).mp. OR (drug$ adj3 error$).mp. OR (mistak$ adj3 medic$).mp. OR (surgic$ adj3 error$).mp. OR (quality$ adj3 health$ adj3 care$).mp. OR (quality$ adj3 healthcare$).mp. OR (quality$ adj3 of adj3 care$).mp. OR exp Professional Competence/ OR (professional$ adj3 competenc$).mp. OR (technical$ adj3 expertise$).mp. OR (expertise$ adj3 generaliz$).mp. OR professionalism$.mp. OR exp Treatment Outcome/ OR (treat$ adj3 outcome$).mp. OR (patient$ adj3 outcome$).mp. OR exp Malpractice/ OR (impair$ adj3 physician$).mp. OR (impair$ adj3 doctor$).mp. OR (disruptive$ adj3 behav$).mp. OR exp Safety/ OR safe$.mp. OR exp Risk OR exp Risk Factors/ OR exp Risk Assessment/ OR exp Risk Management/ OR risk$.mp. OR exp patient satisfaction/ OR (patient$ adj3 satisf$).mp. OR (client$ adj3 satisf$).mp. OR exp human relation/ OR (professional$ adj3 patient$ adj3 relation$).mp. OR (client$ adj3 contact$).mp. OR exp doctor patient relation/ OR (physician$ adj3 patient$ adj3 relation$).mp. OR (doctor$ adj3 patient$ adj3 relation$).mp. OR exp interpersonal communication/ OR communicat$.mp. OR misinform$.mp. OR exp communication disorder/ OR exp communication skill/ OR exp health personnel attitude/ OR attitude$.mp. OR exp clinical competence/ OR (clinical$ adj3 competenc$).mp. OR (clinical$ adj3 skill$).mp. OR exp patient care/ OR (patient$ adj3 cent$ adj3 care$).mp. OR (patient$ adj3 focus$ adj3 care$).mp. OR exp Empathy/ OR empath$.mp. OR exp medical care/ OR (patient$ adj3 care$).mp. OR (informal$ adj3 care$).mp. OR exp professional standard/ OR (standard$ adj3 care$).mp. OR exp standard/ OR exp Self Efficacy/ OR efficacy$.mp. OR exp medical

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Web of Science	[burn out* OR burnout*] AND [physician* OR clinician* OR psychiatry* OR allergist* OR anesthesiologist* OR cardiologist* OR clinical pharmacologist* OR clinical toxicologist* OR dermatologist* OR doctor* OR endocrinologist* OR gastroenterologist* OR gynecologist* OR hematologist* OR immunologist* OR medical biochemist* OR medical geneticist* OR medical microbiologist* OR nephrologist* OR neurologist* OR neuropathologist* OR neuroradiologist* OR occupational physician* OR oncologist* OR ophthalmologist* OR pathologist* OR pediatrician* OR physician* OR psychiatrist* OR radiologist* OR rheumatologist* OR surgeon* OR urologist* OR consultant*] AND [error* OR health* care*OR healthcare* OR quality* OR misdiag* OR mistak* OR competenc* OR expertis* OR professionalism* OR outcome* OR impair* OR disruptive* OR safe* OR risk* OR satisf* OR relation* OR contact* OR communicat* OR misinform* OR attitude* OR skill* OR care* OR empath* OR standard* OR audit* OR hazard* OR malpractic* OR negligen* OR morbidit* OR infection* OR practice* pattern* OR prescrib* pattern* OR mortalit* OR death* OR fatalit* OR drug* OR adverse* OR poison* OR toxic* OR injur*]

Risk of Bias Assessment Checklist

Author(s)	1	2	3	4	5	6	7	8	9	Total Score
Anagnostopoulos et al. (2012)[31]	0	1	1	1	1	1	1	1	0	7
Halbesleben et al. (2008)[32]	0	0	1	0	1	1	1	1	0	5
Hayashino et al. (2012)[30]	0	1	1	0	1	1	1	1	1	7
Klein et al. (2010)[5]	1	0	1	0	1	1	1	1	0	6
Rabatin et al. (2016)[29]	1	0	1	0	1	0	1	1	1	6
Ratanawongsa et al. (2008)[33]	0	1	0	1	1	1	1	1	0	6
Shanafelt et al. (2010)[42]	0	1	0	0	1	1	1	1	0	5
Shirom et al. (2006)[43]	0	0	1	0	1	1	1	1	0	5
Travado et al. (2005)[34]	0	1	0	0	1	1	0	1	0	4
Weigl et al. (2015)[45]	0	1	1	0	1	1	1	1	0	6
Wen et al. (2016)[46]	0	0	1	0	1	1	1	0	0	4
Weng et al. (2011)[35]	0	1	0	1	1	1	0	1	0	5

Risk of Bias Assessment Criteria

1. Study population is well described to facilitate understanding about the generalizability of the results based on the study sample (e.g., age, sex, location of the study, physician specialty, practice location)
2. Data collection methods that address the risk of bias are described
3. Participation/response rate was at least 50% on average
4. The psychometric properties of the quality of care outcome measure have been tested
5. Statistical method was appropriate for the question being answered
6. Statistical significance of associations were tested and reported
7. Study controlled for at least one confounder such as sex or age in the analyses
8. Physician matched with patient
9. Longitudinal data was used