Title: Healthcare Workers' Perceptions of Patient Safety Culture in United States Hospitals: A Systematic Review and Meta-Analysis

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Author names:

1. Ganesh Chilukuri
2. S. Thomas Westerman

Degrees and Affiliations:

1. First-year Medical Student, Drexel University College of Medicine, Philadelphia, USA
2. MD. Hahnemann Medical College, Drexel University College of Medicine, Clinical Professor, Department of Otolaryngology - Head & Neck Surgery, Philadelphia, USA

ORCID (Open Researcher and Contributor Identifier):

https://orcid.org/0000-0001-5171-6795

https://orcid.org/0000-0002-1099-0381

About the author: Ganesh Chilukuri is a first-year medical student at Drexel University College of Medicine class of 2027.

Corresponding author email: chganesh23@gmail.com

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Personal, Professional, and Institutional Social Network accounts.

- **Facebook:**

- **Twitter:**
- **Instagram:** https://www.instagram.com/g.chilukuri/?hl=en
- **Linkedin:** https://www.linkedin.com/in/ganesh-chilukuri-17a942184/ , https://www.linkedin.com/in/samuel-westerman-19a851239/

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ABSTRACT.

Background: Despite having the highest healthcare spending, the United States of America is seeing marginal overall impacts on patient outcomes within the developed world. Studying patient safety culture (PSC), as assessed by the Hospital Survey on Patient Safety Culture (HSOPSC), can provide insights into the status of patient safety culture: an indicator of overall patient safety and attitudes around medical errors. The purpose of this study is to examine patient safety culture in United States hospitals across professional categories via a systemic review and meta-analysis of published literature.

Methods: Embase, PubMed (Medline), Web of Science, Scopus, and AHRQ's Bibliography were consulted for identifying studies. A total of 31 articles met the eligibility criteria for inclusion, which garnered 608,443 survey participants in a national population of hospital healthcare professionals. For each professional category of PSC, a fixed and random-effects meta-analysis was performed, and a subgroup analysis was also conducted to measure differences in perceptions of PSC based on type of healthcare professional.

Results: The HSOPSC composite average across all the studies was 61.3% positive responsiveness, indicating a need for improvement in patient safety. "Teamwork within units" had the highest positive PSC perception while "nonpunitive response to error" and "handoffs and transitions" scored the lowest. Furthermore, healthcare trainees and physicians seemed to have overall worse perceptions of patient safety culture compared to other professional subgroups, indicating the potential impacts of inexperience and a culpability culture on patient safety and medical error in hospitals.

Discussion: Hospitals should consider interventions—such as teamwork training and error-reporting systems—to address the weak dimensions of patient safety culture, thus improving patient safety measures and reducing the incidence of medical errors.

Key Words: Patient safety, Patient Safety Culture, Hospital Survey on Patient Safety Culture

INTRODUCTION.

According to the World Health Organization, patient safety refers to "the prevention of errors and adverse effects to patients associated with health care" and "to do no harm".[1] Threats toward patient safety can be attributed to medical errors both at the individual and organizational levels.[2-3] "To Err is Human" reported that as many as 98,000 people die of hospital medical errors,[3] and substantial efforts have been made recently to identify sources of error, develop safety measures, and create harm-prevention policies in United States hospitals.[4-5] Hospital errors and treating patients due to these errors account for more than 15% of healthcare spending in developed countries, including the US.[6] Furthermore, around 1 in every 10 patients is harmed in healthcare due to safety lapses, an indicator of low-quality healthcare, leading to a global figure of 3 million deaths annually.[7-8] As a result, addressing patient safety in health systems, like private hospitals and hospital networks, has become a crucial aspect of improving the quality of patient care.

Enhancing safety culture in healthcare settings has been recognized as an element for improving patient safety, treatment outcomes, and overall quality of health.[9-11, 36] Patient safety culture (PSC) refers to the shared perceptions of healthcare professionals around the procedures, norms, values, and attitudes relating to a culture of preventable errors.[12] As such, health organizations with strong PSC—characterized by trust and teamwork amongst staff, effective communication between members, and shared perceptions about the importance of patient safety—are associated with having more favorable outcomes and lower frequency of medical errors.[13-15]

The Hospital Survey on Patient Safety Culture (HSOPSC) created by the Agency for Healthcare Research and Quality (AHRQ) in the USA is a multi-dimensional, psychometrically-sound tool that measures patient safety culture in the hospital setting.[16-17] Currently, two versions of the HSOPSC exist, and both versions 1.0 (created in 2014) and 2.0 (developed in 2019) are available. Considering its development in the United States, the HSOPSC has been adopted and utilized by hundreds of hospitals nationwide.[18] Assessing health institutions in the United States is educationally necessitated for two primary reasons: economics and patient outcomes. First of all, the US has one of the highest spending rates for medical care, potentially twice as much as the other developed nations; some of these costs are due to medical errors and preventable administrative issues.[19-21] Secondly, the United States population has a lower average life expectancy and a higher *avoidable* mortality rate than other middle- or high-income countries.[22] In other words, despite having the greatest healthcare spending rate, the United States of America is seeing marginal overall impacts on patient outcomes within the developed world. Studying PSC in hospitals can provide insights into the status of patient safety and the culture of medical/avoidable errors in the United States. In this context, the purpose of this study is to examine patient safety culture in US hospitals across professional categories through a systemic review and meta-analysis of published literature.

METHODS

2.1. Study Aims and Protocol: This review aims to identify studies that have used HSOPSC to measure PSC at United States hospitals and to describe their main findings relating to specific safety culture composites. Additionally, the present study sought to summarize the HSOPSC surveys by means of systematic review and meta-analysis. This study, utilizing a living systematic review and meta-analysis,[23-24] was prepared and implemented by both authors. The literature search was conducted according to protocols set by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).[25] This study is registered to PROSPERO with the following registration number: CRD42024543348.

2.2. Search Strategies: The following databases were consulted for identifying studies: Embase, PubMed (Medline), Web of Science, and Scopus. The search strategy involved implementing a combination of the following keywords using the Boolean operators 'OR' and 'AND': "Patient safety culture", "HSOPSC", and "SOPS". To maximize inclusion of relevant studies, the AHRQ Reference Bibliography List was consulted. Importantly, the AHRQ reference bibliography includes articles that are not limited to the four databases mentioned above. The search strategies for each database are given in **Supplemental Table 1**. 57 studies from the AHRQ bibliography were incorporated in the screening phase.

2.3 Eligibility Criteria and Study Selection: There is much variety in the instruments that are used to assess patient safety culture perceptions amongst healthcare professionals.[26-27] As a result, the authors selected articles that meet the following inclusion criteria: (i) studies used Hospital SOPS Version 1.0 to measure dimensions of PSC; (ii) studies show data from US healthcare systems; (iii) studies are full-text and available in English. Furthermore, the following articles were excluded: (i) studies in the form of letters, conferences, commentaries, and patient reports; (ii) studies performed outside of hospital setting; (iii) studies using benchmark data without mentioning sampling/eligibility criteria; (iv) studies with data from already-identified articles; (v) studies duplicated across databases. Previous reviews done in developing countries and European countries also followed similar inclusion and exclusion criteria.[12-17] Some of these reviews excluded studies that only included one unit of a hospital or one professional category.[13-14] However, the authors decided to include such studies, agreeing that every unit and staff category plays a role in representing a US hospital and its safety culture. Two authors independently screened the title/abstract to determine eligibility for full-text review. Then, these selected studies were comprehensively evaluated based on the aforementioned criteria by both reviewers. Disagreements for inclusion were resolved by additional, collaborative full-text analysis and consensus; if consensus could not be attained, an impartial third-party reviewer was consulted to make a final decision. The reviewers/authors involved in this study have no conflicting interests.

2.4. Data Extraction: Two reviewers summarized data from the included studies using a standardized data extraction sheet in Microsoft Excel. The minimum information was extracted from each study: citation, publication year, study site, number of hospitals included (N), sample size of survey respondents (n), and professional categories. Most importantly, all data relating to the 12 dimensions evaluated by the hospital SOPS 1.0 were extracted for qualitative and quantitative analysis. Any additional information regarding interventions or safety culture improvement programs was qualitatively described.

Considering the purpose of this study is to assess safety culture in the US using the HSOPSC, an understanding of the survey is crucial. The HSOPSC measures 12 dimensions of patient safety culture, with three to four questions to assess each dimension, totaling 42 items. The dimensions are measured using a 5-point Likert scale, ranging from 'never' to 'always' and 'strongly disagree' to 'strongly agree', for both negatively and positively worded items.[16] Following the Likert scale, many studies evaluate PSC by calculating mean scores, ranging from 0 to 5, for each dimension. A score closer to 5.0 denotes more positive perceptions of safety culture amongst hospital staff, allowing for extrapolation and conversion.[28] The AHRQ and the majority of literature in the field recommend using the percentage of positive responses obtained in each composite dimension by the survey participants as a measure of safety culture status. While both methods of presenting PSC data are valid, this systematic review specifically uses percentage of positive responses as the quantitative measure of safety culture. A high percentage of positive responses (>75%) indicates a general strength for the PSC dimension within the surveyed population. Lower positive response scores (<50%) are considered weak dimensions needing further study and improvement.[28] The 12 dimensions measured by the HSOPSC 1.0 and their respective definitions are given in **Table 1**.

2.5. Risk of Bias: The selected articles were assessed for risk of bias (i.e. the quality score) using the JBI critical appraisal toolkit.[29] This 10-item checklist assesses (i) sample representativeness, (ii) appropriate recruitment of participants, (iii) sample size adequacy, (iv) description of sample and study site, (v) data analysis, (vi) presence of objective, standard criteria for measurement, (vii) reliable measurement, (viii) appropriate statistical analysis, (ix) accounting for confounding factors/subgroups/differences, and (x) identification/analysis of subpopulations.[30] Both reviewers rated each article in this review using the JBI critical appraisal checklist, and scores were averaged, culminating in the quality scores shown in table 2.

2.6. Statistical Analysis: Data extracted from the studies were organized, analyzed, and graphed using Microsoft Excel and RStudio. For each HSOPSC dimension, statistical analysis was performed by calculating mean positive scores, standard deviation, standard error, and 95% confidence intervals.[31] Meta-analysis was performed using a comparison of results using both a fixed and random-effect analysis, a conservative approach for the meta-analysis of systematic studies.[32-33] A random-effect analysis was done because of the number of studies included in this review (31 total articles) and the understanding that studies utilizing HSOPSC yield high heterogeneity in the results. Heterogeneity was assessed by deriving the inverse variance in a fixed-effects model, expressed as the I^2 statistic percentage.[34] Then, two subgroup analyses were done to measure potential differences in PSC based on the sample composition of studies.[31] For the first subgroup analysis, studies were grouped into two categories: those that assessed healthcare trainees (residents, fellows, trainee nurses, etc) vs those that surveyed permanent staff members. The second subgroup analysis regrouped the studies based on three professional categories: nurses, physicians, and a mix of professions. Importantly, a few individual studies provided separate HSOPSC data for each subgroups; the reviewers extracted all subgrouped data to include in the meta-analysis. For example, Bump et al., 2017 provided separate results for trainees vs staff members, and both categories of data were collected in Excel and included in the statistical comparison. Statistical analysis included two-tailed tests of statistical probability, and P-values < 0.05 were deemed significant.[33]

RESULTS.

The database searches identified 658 papers for screening. An additional 57 papers from the AHRQ reference bibliography were added to this screening pool.[34] Initial screening for language, location, and removal of duplicates eliminated 406 articles, leaving 309 studies for title/abstract screening. Two reviewers assessed the abstracts/titles of the papers to identify 77 articles total for the full-text review phase. A total of 31 articles met the eligibility criteria for inclusion. **Figure 1** shows a PRISMA flowchart for the literature selection process.

For the purpose of this review, all 31 studies were conducted in the United States, ranging from nationwide to single hospital samples. The articles were all published within the last 15 years and used the Hospital SOPS 1.0 to assess PSC. The 31 studies totaled (at least) 608,443 participants, ranging from 42 participants at a specialized hospital unit to 196,462 participants in a national population of healthcare professionals. Most studies included a mix of professional categories, but a small number of studies provided compartmentalized HSOPSC results focused exclusively on nurses (8 papers) and physicians (5 papers). Moreover, only four studies included HSOPSC results that specifically denoted trainee professionals vs permanent staff members. **Table 2** provides an overview and qualitative descriptions of all 31 studies.

The studies demonstrated good methodological quality scores with an average quality score of 9 points out of 10, with 15 studies achieving a maximum score. The studies that lost points were mainly due to errors in participant recruitment or sample/site reporting.

“Teamwork within units” dimension was reported to be the highest or one of the highest-rated composites in the majority of the studies, 26 of 31 studies. Meanwhile, “handoffs & transitions” and “nonpunitive response to error” consistently had the lowest or one of the lowest PSC ratings, 22 of 31 studies each. The meta-analysis of the 12 dimensions of safety culture also corroborated these qualitative findings. Only “teamwork within units” yielded a positive response rate above seventy-five percent, at 75.9%. “Handoffs & transitions” and “nonpunitive response to error” produced positive responsiveness below fifty percent, at 46.6% and 47.7%, respectively. The meta-analysis revealed high heterogeneity values across the survey dimensions and composite average (**Table 3**). The HSOPSC composite average across all the studies was 61.3% positive responsiveness, indicating a perception of patient safety culture that requires improvement. A forest plot of studies with a positive PSC composite average by workplace status (trainee vs staff member) is shown in **Figure 2**.

Four studies provided HSOPSC results for trainee participants specifically. Two studies provided multiple HSOPSC results to demarcate potential differences between trainees and permanent staff, so both studies were included in each subgroup.[61-62] The trainee subgroup had a positive composite average of 53.9% while the staff subgroup reported a positive composite average of 62.8%, leading to an overall composite average of 61.3%. The difference in HSOPSC composite averages between trainees and staff (~9%) was found to be statistically significant with a p-value of 0.0111, indicating that trainees seem to have worse perceptions of patient safety than permanent hospital staff.

Five studies provided HSOPSC results for physicians while eight studies reported data from nurse participants. Two studies provided separate data sets for physicians and nurses; both were included in the subgroup analysis.[41, 61] One study denoted individual results for physicians and a mix of professions, so both of these datasets were also included in the respective subgroups.[62] Physicians were the group with the lowest PSC perception with an HSOPSC composite average of 54.8%, followed by nurses with an average of 58.7%, and studies with a mix of professions had the highest composite average of 64.1%. The meta-analysis showed that physicians and a mix of professions had a statistical difference in safety culture perceptions for multiple dimensions: organizational learning–continuous improvement, overall perceptions of patient safety, feedback and communication about error, frequency of events reported, handoffs and transitions, nonpunitive response to error, and overall HSOPSC composite average. Physicians always seemed to report lower PSC perceptions. Additionally, physicians reported a statistically significant lower PSC rating than nurses for one dimension: feedback and communication about error. A bar graph showing differences in HSOPSC dimension between physicians, nurses, and a mix of professions is provided in **Figure 3**.

DISCUSSION.

The present review used the PRISMA protocol to find studies that used the HSOPSC to assess PSC in United States hospitals. The meta-analysis found both strengths and weaknesses in perceptions of patient safety among and between professional categories. In the included studies, HSOPSC was answered by physicians, nurses, technicians, pharmacists, and administrators. Some of the studies provided survey results for specific subgroups of healthcare professionals (such as trainees vs permanent staff), but the majority of studies (27 papers) showed integrated results for a mix of hospital professions. The overall HSOPSC composite average calculated from all 31 studies was 61.3%, indicating an overall need for improvement in US hospitals. Hospitals that used teamwork and collaboration training interventions showed statistically significant improvements in patient safety culture.[40, 43, 54, 57, 63] It is possible that adopting programs such as the TOPS project and TeamSTEPPS in the context of specific hospitals/medical centers may result in higher perceptions of PSC.[68-69] Improving PSC may decrease the rate of medical errors and improve overall patient safety in US hospitals.[70]

"Teamwork within units" had the greatest positive responsiveness in terms of patient safety culture. Similar results were found in systematic reviews and meta-analyses of HSOPSC in other areas of the world including Latin America, the Middle East, Europe, and international studies.[13-14, 71-73] This suggests the presence of global strengths in teamwork within hospital units, potentially due to the collaboration and communication that develops between closely working healthcare professionals. Meanwhile, in the United States and global communities, "nonpunitive response to error" and "handoffs and transitions" were the lowest-rated PSC dimensions. Weak perceptions of nonpunitive response to error may reflect a culture of culpability in the US healthcare system. Healthcare professionals may fear negative consequences for making mistakes, leading to a failure to report mistakes and fix said errors. Brattebø and colleagues recommend a participating system for the improvement of patient safety errors as opposed to a punishment system.[76] Furthermore, one study in this review looked at hospitals using a voluntary error-reporting system,[56] which used a standardized taxonomy in patient files to support a reporting culture. This procedure, in conjunction with safety briefings about communicating about and learning from errors, resulted in significant improvements in hospital PSC and overall safety measures. The authors recommend implementing similar error-reporting systems to enhance patient safety practices and prevent avoidable medical errors. Other systems such as chart reviews, trigger tools, etc. are also beneficial for capturing adverse events and errors. Finally, the weak dimension of "handoffs and transitions" refers to the transfer of information across hospital units and shift changes. There seems to be a deficit in how hospitals standardize effective handoffs and transitions for the benefit of patients. Recent studies recommend using an I-PASS system in a limited-interruption location to facilitate the proper transfer of information between professional units and shifts.[74-75]

Evaluating perceptions of PSC assumes the consideration of many factors that make US hospitals unique. One factor is the differences between varying stages of career, specifically hospital trainees versus permanent staff members. Trainees include residents, fellows, students, and healthcare prospects while permanent staff are healthcare workers who are established full-time or by contract in their hospitals. There was a statistically significant difference in HSOPSC composite averages between trainees and staff (~9%),

indicating that trainees seem to have worse perceptions of PSC than established staff in the US. The most likely explanation for lower PSC ratings among trainees is inexperience and lack of confidence, especially regarding patient safety measures and performance of medical errors.[77] Additional studies indicate that trainees have greater fears about bad outcomes, reprimands, and communication, all of which contribute to worse PSC responses.[78-79] Another likely explanation is that seasoned employees are affected by an acceptance or normalization of deviance. Based on these findings, the authors recommend hospitals include patient safety measures in their trainee and staff curriculums; addition of patient safety into graduate school curriculums also warrants consideration. Furthermore, staff should facilitate a collaborative integration of trainees into their medical teams. These practices may improve perceptions of some PSC dimensions among trainees in order to prevent/report errors and uphold patient safety.[61-62]

There is much variability in PSC perceptions between and within professional categories. In this particular review of United States HSOPSC studies, safety culture was rated lower for physicians compared to nurses and a mix of professions in the hospital setting. While physicians scored lower PSC ratings for many dimensions, the most significant category was “feedback and communication about error.” The meta-analysis revealed that more physicians feel like errors are not reported or discussed compared to nurses and other medical professionals. Once again, this points to a negative culture of culpability amongst healthcare professionals,[14, 83-84] which is preventing the maintenance of patient safety. Another interesting note is that recent studies found a relatively strong association between professional/personal burnout and lower perceptions of safety culture as well as greater risks in patient safety and medical error.[80-82]

The authors acknowledge that this review is open to some limitations. First of all, articles were searched using four databases, which were believed to be effective for collecting eligible studies. Some articles may have been missed, so to maximize the inclusion of eligible studies, the authors also consulted the AHRQ Bibliography, adding 57 additional records for the screening. Moreover, the studies demonstrated good methodological quality scores, indicating the presence of well-conducted evaluation of PSC in United States hospitals. Regardless of quality scores, all the studies exhibited high heterogeneity of results similar to other reviews, which may make any outlined recommendations more challenging to implement.[13-14, 71-73] Heterogeneity was possible due to the wide-ranging sample sizes of included studies, multiple professional categories, and nationwide locations. Small study effects and publication bias may have also impacted results. Moreover, HSOPSC is a survey tool with good psychometric properties,[28] but based on implementation and sampling, the results are open to inconsistencies, which may have also contributed to increased variability during meta-analysis. Despite these limitations, this review provides a combined analysis of patient safety culture perceptions amongst nationwide US healthcare workers with a high sample of responses. As a result, the findings in this study provide generalizable insights on potential obstacles to achieving safer healthcare standards and better medical error reporting practices in the United States. Future research on practical interventions (at the clinical, administrative, and educational levels) addressing weaknesses in patient safety culture would be beneficial for improving patient safety and reducing healthcare errors in the hospital.

SUMMARY - ACCELERATING TRANSLATION

Assessing patient safety culture across hospitals in the United States allows researchers and policy administrators to identify areas of strength and weakness with regard to upholding patient safety and reducing medical error. The United States spends a lot of funding on healthcare with marginal improvements in patient safety, so improving the culture of patient safety may be a vital step in improving the overall healthcare quality for staff and patients in hospitals. There is much variability in perceptions of safety culture amongst different healthcare professionals, but trainees and leadership positions (i.e. physicians) seemed to report lower PSC, potentially due to the impact of inexperience, lack of deviance from regulation, and a culture of culpability. Quality improvement strategies, such as teamwork training and error-reporting systems, should facilitate effective communication, feedback about medical errors, and a culture of learning—all of which foster a safer environment for patients and staff in the hospital setting.

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FIGURES AND TABLES.

Figure 1: PRISMA 2020 flowchart for systematic study selection.

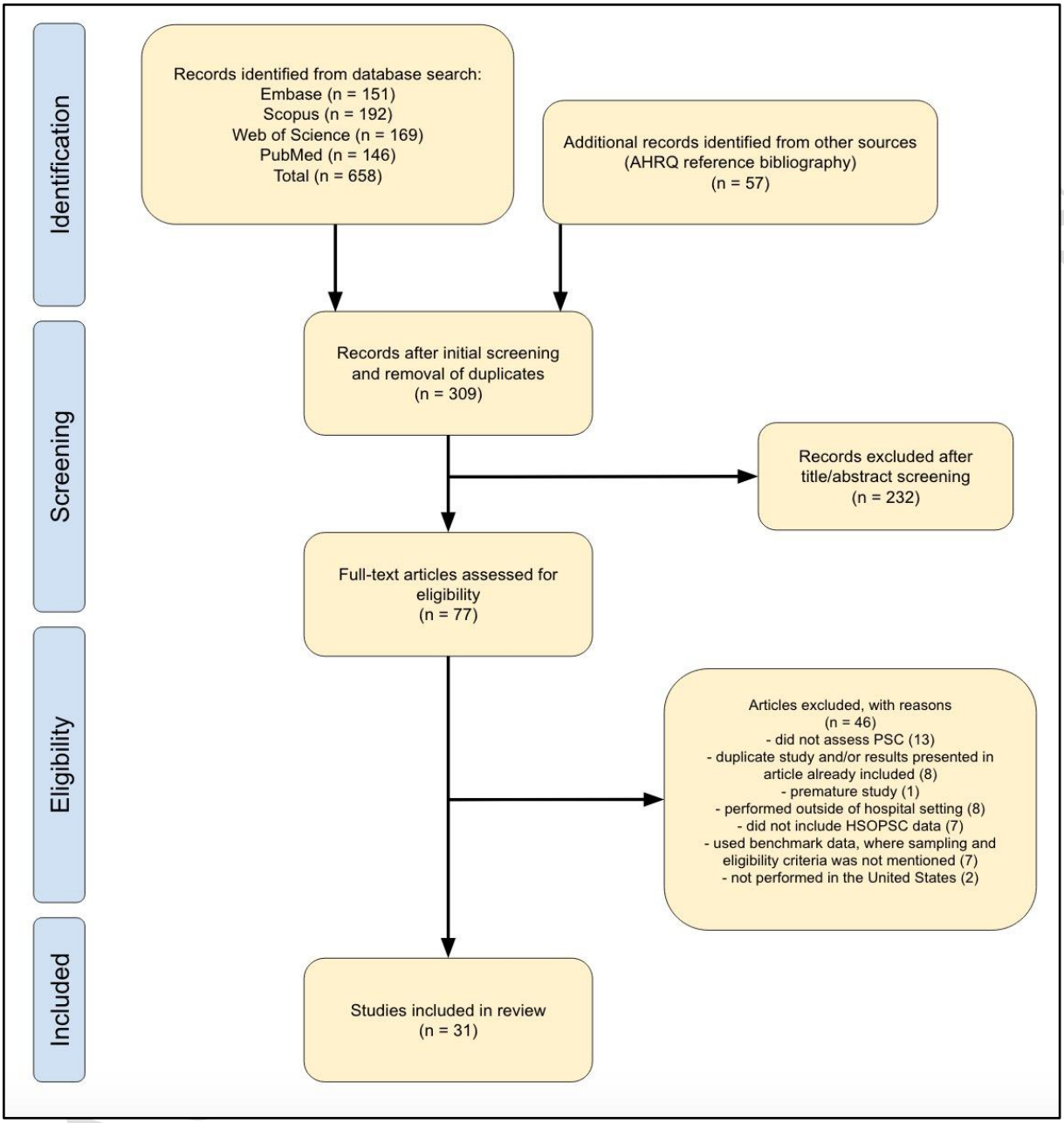

Figure 2. Forest plot of HSOPSC composite average for all studies (n = 31) by workplace status, trainees vs staff members.

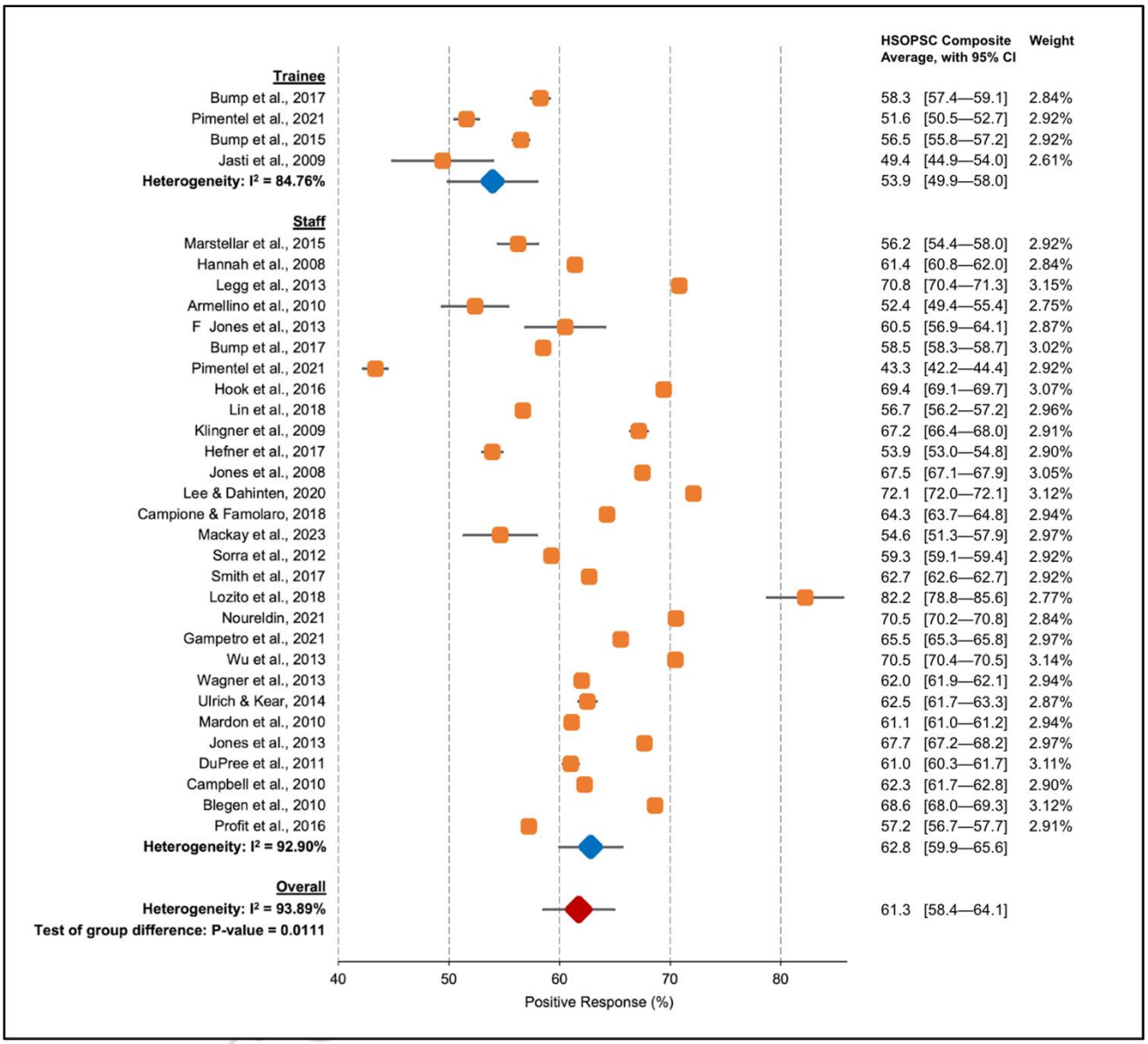

Figure 3. Bar graph on dimensions of HSOPSC positive responsiveness by professional category, with 95% CI. (* p-value ≤ 0.05 , ** p-value ≤ 0.01 , *** p-value ≤ 0.001)

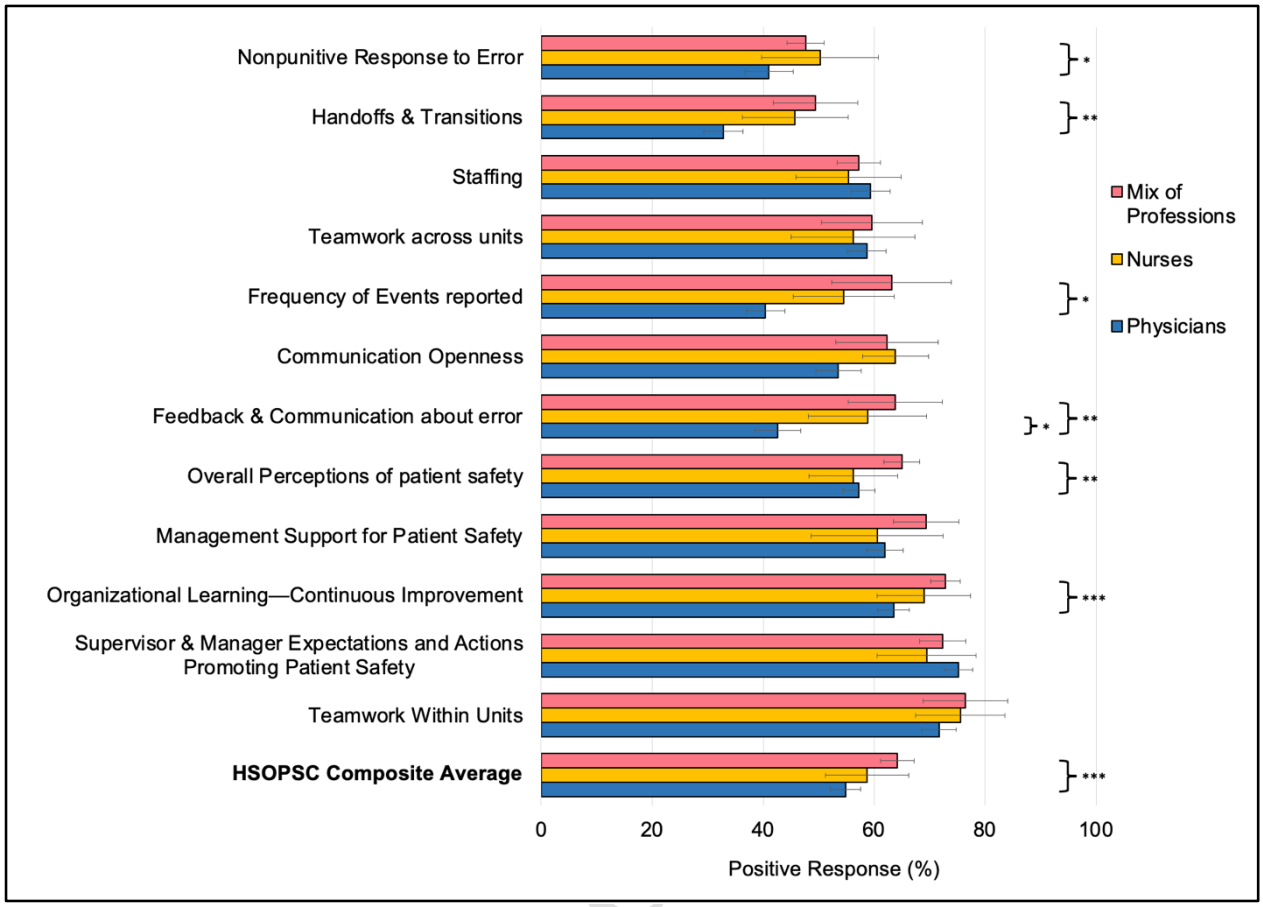

Table 1. Patient safety culture measures and definitions.

Composites	Items	Definitions
Teamwork Within Units	4	Staff support each other, treat each other with respect, and work together as a team.
Supervisor & Manager Expectations and Actions Promoting Patient Safety	4	Supervisors/managers consider staff suggestions for improving patient safety, praise staff for following patient safety procedures, and do not overlook patient safety problems.
Organizational Learning—Continuous Improvement	3	Mistakes have led to positive changes and changes are evaluated for effectiveness.
Management Support for Patient Safety	3	Hospital management provides a work climate that promotes patient safety and shows that patient safety is a top priority.
Overall Perceptions of patient safety	4	Procedures and systems are good at preventing errors and there is a lack of patient safety problems.
Feedback & Communication about error	3	Staff are informed about errors that happen, are given feedback about changes implemented, and discuss ways to prevent errors.
Communication Openness	3	Staff freely speak up if they see something that may negatively affect a patient and feel free to question those with more authority.
Frequency of Events reported	3	Mistakes of the following types are reported: (1) mistakes caught and corrected before affecting the patient, (2) mistakes with no potential to harm the patient, and (3) mistakes that could harm the patient but do not.
Teamwork across units	4	Hospital units cooperate and coordinate with one another to provide the best care for patients.
Staffing	4	There are enough staff to handle the workload and work hours are appropriate to provide the best care for patients.
Handoffs & Transitions	4	Important patient care information is transferred across hospital units and during shift changes.
Nonpunitive Response to Error	3	Staff feel that their mistakes and event reports are not held against them and that mistakes are not kept in their personnel file.
HSOPSC Composite Average	42	Average of the 12 composite scores

Table 2. Overview and qualitative descriptions of selected studies.

	Author/Study	Study Site(s)	Number of Hospitals/Medical Centers (N)	Number of Participants (n)	Main Findings	Professional Category	Quality Score
1	Jasti, 2009 [37]	Pittsburgh, PA - UPMC Presbyterian Hospital	1	58	"Supervisor/Manager Expectations & Actions Promoting Patient Safety" and "Teamwork within units" were the highest scored HSOPSC dimensions (75% and 69% positive response rate, respectively). "Handoffs & Transitions" and "Feedback & Communication About Error" scored the lowest (19% and 27% positive response rate, respectively). Internal medicine house staff at earlier stages in their residency training scored higher in 11 out of 12 dimensions.	Physicians (residents)	8
2	Profit, 2016 [38]	Neonatal Intensive Care Units in Californian hospitals	44	2073	"Teamwork Within Units" was the highest scored HSOPSC dimension (74% positive response rate). "Communication Openness" and "Feedback & Communication About Error" scored the lowest (49.3% and 49.2% positive response rate, respectively). Patient safety culture ratings generally decreased as the number of admissions, beds, and staff experiences levels increased across the sample of NICUs.	Mix of Professions	9
3	Bump, 2015 [39]	Pennsylvania - UPMC	10	955	"Teamwork Within Units" and "Supervisor/Manager Expectations & Actions Promoting Patient Safety" were the highest scored dimensions (72% and 80% positive response rate, respectively). Meanwhile, "Handoffs & Transitions" and "Nonpunitive Response to Error" scored the lowest (39% and 42% positive response rate, respectively). Compared to practicing providers, resident and fellow doctors seemed to have lower overall perceptions of PSC.	Physicians (residents + fellows)	7
4	Blegen, 2010 [40]	California - UCSF, El Camino Hospital, Kaiser Permanente SF Hospital	3	368	"Teamwork Within Units" and "Organizational Learning—Continuous Improvement" scored the highest positive response rates (76.6% and 76%, respectively). "Handoffs & Transitions" and "Nonpunitive Response to Error" scored the lowest (57.4% and 57.6% positive response rate, respectively). The TOPS project, involving multidisciplinary team training programs and communication interventions, seemed to improve PSC in hospital medical units.	Mix of Professions	9
5	Campbell, 2010 [41]	Boston, MA - Massachusetts General Hospital	1	2163	"Teamwork Within Units" was the highest scored HSOPSC dimension (85% positive response rate). "Handoffs & Transitions", "Frequency of Events Reporting", and "Feedback & Communication About Error" scored the lowest (45%, 49%, and 51% positive response rate, respectively). At this hospital, patient safety climate varied drastically across units and unit types; furthermore, physicians offered more negative PSC ratings.	Physicians, Nurses	10

6	DuPree, 2011 [42]	NYC, NY - Mount Sinai Medical Center	1	325	At the time of study, "Organization Learning—Continuous Improvement" scored the highest at 68% positive response, but "Teamwork Within Units" was consistently rated around 65% positive response. "Frequency of Events Reporting" was scored the lowest at 54% positive responsiveness. Implementing a multidisciplinary Code of Professionalism for staff members to follow showed significant improvements in safety culture in this hospital.	Mix of Professions	10
7	Jones, 2013 [43]	Small Rural Hospitals in Central America	Intervention Hospitals: 24 Static Hospitals: 13	Intervention Hospitals: 2137 Static Hospitals: 1328	"Teamwork Within Units" and "Management Support for Patient Safety" were the highest scoring dimensions (82% and 81% positive response rate, respectively). "Handoffs & Transitions" and "Nonpunitive Response to Error" scored the lowest (both 54% positive response rate). TeamSTEPPS intervention, a training program teaching the knowledge and skills that comprise effective teamwork, was associated with greater positive PSC scores.	Mix of Professions	10
8	Mardon, 2010 [44]	Nationwide	179	56480	"Teamwork Within Units" and "Supervisor/Manager Expectations & Actions Promoting Patient Safety" were the highest scored dimensions (79% and 74% positive response rate, respectively). Meanwhile, "Handoffs & Transitions" and "Nonpunitive Response to Error" scored the lowest (44% and 42% positive response rate, respectively).	Mix of Professions	10
9	Ulrich & Kear, 2014 [45]	Nationwide	--	929	Among nephrology nurses: "Teamwork" items received a high positive PSC score (80.7%) while "Handoffs & Transitions" scored the lowest in HSOPSC rating (32.75%).	Nurses	10
10	Wagner, 2013 [46]	Nationwide	622	196462	"Teamwork Within Units" and "Supervisor/Manager Expectations & Actions Promoting Patient Safety" were the highest scored dimensions (79% and 75% positive response rate, respectively). Meanwhile, "Handoffs & Transitions" and "Nonpunitive Response to Error" scored the lowest (both 44% positive response rate,).	Mix of Professions	8
11	Wu, 2013 [47]	Nationwide	884	106710	"Teamwork Within Units" was the highest positively scored dimension (78.2%). Meanwhile, "Handoffs & Transitions" and "Nonpunitive Response to Error" scored the lowest (both approximately 62% positive responsiveness). Nurses with long working hours/shifts had lower PSC ratings for the "Teamwork Within Units" and "Staffing" Dimensions.	Nurses	9

12	Gampetro, 2021 [48]	Nationwide - Pediatric Units	287	6682	"Teamwork Within Units" was the highest positively scored dimension (82.8%). Meanwhile, "Staffing", "Handoffs & Transitions", and "Nonpunitive Response to Error" scored the lowest (53.2%, 52.8%, and 54.2%, respectively). There are significant differences regarding perceptions of safety culture between hospitals/specialty units as well as between pediatric physicians and nurses	Mix of Professions	10
13	Noureldin, 2021 [49]	Nationwide - Hospital Pharmacies	--	7,671	"Teamwork Within Units" and "Supervisor/Manager Expectations & Actions Promoting Patient Safety" scored relatively high positive responsiveness ratings with 78.7% and 77.6%, respectively. Meanwhile, pharmacists scored "Staffing" lower at 55.2% positive responsiveness. More experienced pharmacists were more likely to report errors in the workplace. Furthermore, pharmacists at larger hospitals were less likely to report errors and had lower percent positive scores across all the PSC domains.	Pharmacists	9
14	Lozito, 2018 [50]	Pennsylvania	1	71	After implementing the Good Catch Campaign (an educational intervention associated with the implementation of a standardized electronic reporting and debriefing system), staff members reported higher positive responsiveness in all five tested PSC domains: "Communication Openness", "Feedback & Communication about Error", "Frequency of Event Reporting", "Nonpunitive Response to Error", and "Organization Learning—Continuous Improvement". "Nonpunitive Response to Error" scored the lowest at 57% positive response rate.	Mix of Professions	9
15	Smith, 2017 [51]	Nationwide	164	140,316	"Teamwork Within Units" was the highest positively scored dimension (81%). Meanwhile, "Handoffs & Transitions" and "Nonpunitive Response to Error" scored the lowest (43% and 44% positive responsiveness, respectively). Hospitals where staff have more positive perceptions of PSC are associated with higher Consumer Reports hospital safety scores.	Mix of Professions	10
16	Sorra, 2012 [52]	Nationwide	73	26791	"Teamwork Within Units" was the highest positively scored dimension (77%). Meanwhile, "Handoffs & Transitions" and "Nonpunitive Response to Error" scored the lowest (both 40% positive response rate). Hospitals where staff have more positive PSC perceptions were associated with patients having more positive care experiences, even after controlling for hospital size and ownership.	Mix of Professions	10

17	Mackay, 2023 [53]	Southeast US - Children's Hospital	1	Intervention Unit: 44 Comparison Unit: 42	Implementing a Daily Safety Huddle improve the positive PSC perception in one dimension: Communication Openness, which also had the highest positive responsiveness at 68.42%. In this study, "Frequency of Events Reported" had the lowest positive response rate at 41.07%. Further research is needed to elucidate the impact of daily safety huddles in nursing.	Nurses	9
18	Campione & Famolaro, 2018 [54]	Nationwide - Acute Care Hospitals	536	1608	"Teamwork Within Units" was the highest positively scored dimension (81.1%). Meanwhile, "Handoffs & Transitions" and "Nonpunitive Response to Error" scored the lowest (46.6% and 44.7% positive responsiveness, respectively). Improvement in PSC perceptions were associated with goal setting, action planning, implementation of multifaceted programs, and consistent measurement of hospital culture across all levels of staff.	Mix of Professions	10
19	Lee & Dahinten, 2020 [55]	Nationwide	535	34514	"Teamwork Within Units" was the highest scored HSOPSC dimension (80.6% positive response rate). Meanwhile, "Staffing", "Handoffs & Transitions", and "Nonpunitive Response to Error" scored the lowest (64.8%, 63%, and 65%, respectively). In regression analysis, "Staffing" and "Management Support for Patient Safety" were the two strongest predictors of patient safety perception.	Nurses	9
20	Jones, 2008 [56]	Central America - Critical Access Hospitals	21	1374	"Teamwork Within Units" was the highest scoring dimensions (81% positive response rate). "Handoffs & Transitions" and "Nonpunitive Response to Error" scored the lowest (58% and 52% positive response rate, respectively). Simply raising organizational awareness of patient safety and implementing a voluntary error-reporting program were associated with improved perceptions of PSC.	Mix of Professions	10
21	Hefner, 2017 [57]	Midwest US - OSUWMC Hospitals	3	667	"Teamwork Within Units" was the highest scoring dimension at 78% positive responsiveness while "Nonpunitive Response to Error" scored the lowest at 35%. Crew resource management (CRM) training significantly improved positive perceptions of PSC, especially in teamwork and management domains.	Mix of Professions	10
22	Klingner, 2009 [58]	Tennessee Rural Hospitals	8	835	"Teamwork within units" and "Supervisor/Manager Expectations & Actions Promoting Patient Safety" were the highest scored HSOPSC dimensions (83% and 80% positive response rate, respectively). "Staffing", "Nonpunitive Response to Error", and "Handoffs & Transitions" scored the lowest (52%, 50%, and 49%, respectively).	Mix of Professions	9

23	Lin, 2018 [59]	Hawaii - Surgical Units	12	--	"Teamwork Within Units" received the highest positive response of 75% while "Handoffs & Transitions" and "Nonpunitive Response to Error" scored the lowest at 39% and 40%, respectively. Implementing the AHRQ Safety Program for Surgery was associated with reduced surgical site infection rate and increased perceptions of PSC.	Mix of Professions	8
24	Hook, 2016 [60]	Midwest US	4	2011	Higher ratings of hospital culture humility are associated with higher positive perceptions of PSC.	Mix of Professions	10
25	Pimentel, 2021 [61]	Boston, MA - Brigham and Women's Hospital (perioperative staff)	1	431	"Teamwork Within Units" received the highest positive response of 69% while "Frequency of Event Reporting", "Feedback & Communication About Error", and "Handoffs & Transitions" scored the lowest at 35%, 34%, and 30%, respectively. In general, surgery attending physicians perceived the highest PSC while nurses and technicians had the lowest positive PSC ratings.	Physicians (attendings + residents), Nurses, Technicians	10
26	Bump, 2017 [62]	Pennsylvania - UPMC	10	12941	"Supervisor/Manager Expectations & Actions Promoting Patient Safety" and "Teamwork Across Units" were the highest scored HSOPSC dimensions (80%/70% and 77%/75% positive response rate, respectively [MD trainees/Other Staff]). "Handoffs & Transitions" and "Nonpunitive Response to Error" scored the lowest positive responsiveness (41%/46% and 35%/45%, respectively [MD trainees/Other Staff]). Overall, in this integrated health system, MD trainees and other staff report similar positive rates of PSC; however, there are slight differences between domains.	Physicians (residents + fellows), Mix of Professions	8
27	F Jones, 2013 [63]	Memphis, TN - large hospital system's emergency departments	2	47	"Supervisor/Manager Expectations & Actions Promoting Patient Safety" and "Management Support for Patient Safety" were the highest scored HSOPSC dimensions (both 72% positive response rate). "Nonpunitive Response to Error" had the lowest positive responsiveness at 28%. TeamSTEPPS intervention, a training program teaching the knowledge and skills that comprise effective teamwork, was associated with greater positive PSC scores.	Mix of Professions	8
28	Armellino, 2010 [64]	New York - Acute Critical Care Unit at a large tertiary hospital	1	98	"Teamwork Within Units" received the highest positive response of 74.4% while "Nonpunitive Response to Error" scored the lowest at 21.09%. Nurses from more empowered backgrounds seemed to have more positive ratings of PSC, indicating systemic social disparities in safety culture perceptions.	Nurses	9
29	Legg, 2013 [65]	Nationwide - Vascular Interventional Technology Units	--	437	Perceptions of PSC were relatively positive (>50% positive responsiveness) with "Teamwork Within Units" scoring the highest positive response rate at 78.3%. "Handoffs & Transitions" and "Nonpunitive Response to Error" scored the lowest (61.7% and 64.87% positive response rate, respectively).	Technicians	9

30	Hannah, 2008 [66]	West Virginia	26	1,717	"Teamwork Within Units" was the HSOPSC dimension with the highest positive response at 78.7% while "Handoffs & Transitions" and "Nonpunitive Response to Errors" scored the lowest at 41.3% and 38.6%, respectively. There was a significant difference between perceptions of PSC between clinicians and nonclinical staff; overall, clinical staff (i.e. nurses) had more negative ratings of PSC.	Nurses, Administration	10
31	Marstellar, 2015 [67]	Nationwide - Cardiac Surgical Units	5	158	In a sample of cardiac surgical units: "Teamwork Within Units" was the HSOPSC dimension with the highest positive response at 73.5% while "Handoffs & Transitions" and "Nonpunitive Response to Errors" scored the lowest at 39.9% and 37.7%, respectively.	Mix of Professions	10

Table 3. Meta-analysis of HSOPSC dimensions and heterogeneity.

Dimension	Positive Response, % (95% CI)	I^2 (%)
Teamwork Within Units	75.9 (73.5-78.3)	93.7
Supervisor & Manager Expectations and Actions Promoting Patient Safety	72.7 (70.6-74.9)	90.1
Organizational Learning—Continuous Improvement	71.4 (69.2-73.7)	89.9
Management Support for Patient Safety	66.9 (63.9-70.0)	95.4
Overall Perceptions of patient safety	62.0 (59.2-64.8)	95.5
Feedback & Communication about error	60.6 (56.3-64.8)	97.4
Communication Openness	61.6 (58.3-65.0)	96.1
Frequency of Events reported	58.5 (54.3-62.7)	97.7
Teamwork across units	59.3 (55.8-62.8)	96.1
Staffing	57.4 (54.5-60.2)	95.9
Handoffs & Transitions	46.6 (42.9-50.4)	97.5
Nonpunitive Response to Error	47.7 (43.7-51.6)	97.7
HSOPSC Composite Average	**61.3 (58.4-64.1)**	**93.9**

Supplemental Table 1. Search strategies for each database consulted for study selection.

Database	Search Query
Scopus	TITLE-ABS-KEY ("Patient Safety Culture" AND ("hsopsc" OR "sops")) AND (LIMIT-TO (LANGUAGE , "English"))
Embase	SEARCH: 'patient safety culture' AND ('hsopsc' OR 'sops') AND [english]/lim
Web of Science	TS=(Patient safety culture AND (hsopsc OR sops)) Refine by Languages: English
PubMed (Medline)	("Patient safety culture"[All Fields] AND ("hsopsc"[All Fields] OR "sops"[All Fields])) AND (english[Filter])
AHRQ	Browse bibliography for relevant articles according to the inclusion and exclusion criteria. Filters can be applied to limit bibliography to the United States and hospital settings. Articles in the AHRQ SOPS bibliography are accessible with but NOT limited to the four databases mentioned above.