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"Multisource feedback in surgical education: a bibliometric and thematic analysis of instruments used to assess non-technical skills".

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ARTIGO DE REVISÃO

RESUMO

Introdução: As habilidades não técnicas desempenham um papel crítico na prática cirúrgica e são determinantes essenciais da segurança do paciente e do desempenho cirúrgico. O feedback de múltiplas fontes (MSF) representa uma abordagem estruturada, baseada em comportamentos, para a avaliação dessas competências por meio das perspectivas de múltiplos avaliadores em ambientes clínicos. Este estudo foi conduzido como uma revisão bibliométrica e temática da literatura científica que aborda o uso do feedback de múltiplas fontes para avaliar habilidades não técnicas em contextos cirúrgicos. **Métodos**: Estudos empíricos foram identificados por meio de buscas realizadas em nove bases de dados bibliográficas até março de 2025. Técnicas bibliométricas foram utilizadas para caracterizar padrões de publicação e estruturas temáticas, enquanto a síntese temática foi empregada para descrever as competências avaliadas, os instrumentos utilizados e as abordagens de validação. **Resultados**: Quatorze estudos elegíveis foram incluídos na análise final. Os resultados indicam que a literatura sobre o tema ainda é limitada e está predominantemente concentrada em países de alta renda. Comunicação e profissionalismo emergiram como as competências mais frequentemente avaliadas, enquanto liderança, trabalho em equipe e tomada de decisão apareceram de forma menos consistente entre os estudos. Investigações metodológicas e psicométricas predominaram entre as publicações incluídas. **Conclusão**: De modo geral, os achados sugerem um crescente interesse acadêmico no feedback de múltiplas fontes como abordagem para a avaliação de competências não técnicas na educação cirúrgica. No entanto, o número limitado de estudos evidencia a necessidade de maior diversidade contextual, de uma descrição mais clara dos processos de validação e de pesquisas adicionais voltadas ao fortalecimento da padronização e da adaptação transcultural dos instrumentos de avaliação.

Palavras-chave: feedback de múltiplas fontes; feedback 360 graus; habilidades não técnicas; educação cirúrgica.

ABSTRACT

Introduction: Non-technical skills play a critical role in surgical practice and are essential determinants of patient safety and surgical performance. Multisource feedback (MSF) represents a structured, behavior-based approach for assessing these competencies through the perspectives of multiple evaluators in clinical environments. This study was conducted as a bibliometric review and thematic analysis of the scientific literature addressing the use of multisource feedback to assess non-technical skills in surgical contexts. **Methods:** Empirical studies were identified through searches conducted in nine bibliographic databases up to March 2025. Bibliometric techniques were used to characterize publication patterns and thematic structures, while thematic synthesis was used to describe the assessed competencies, instruments, and validation approaches. **Results:** Fourteen eligible studies were included in the final analysis. The results indicate that the literature on this topic remains limited and is concentrated predominantly in high-income countries. Communication and professionalism emerged as the most frequently assessed competencies, while leadership, teamwork, and decision-making appeared less consistently across studies. Methodological and psychometric investigations predominated among the included publications. **Conclusin:** Overall, the findings suggest growing scholarly interest in multisource feedback as an approach to evaluating non-technical competencies in surgical education. However, the limited number of studies highlights the need for greater contextual diversity, clearer reporting of validation processes, and further research aimed at strengthening the standardization and cross-cultural adaptation of assessment instruments.

Keywords: multisource feedback. 360-degree feedback. non-technical skills. surgical education.

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1. INTRODUCTION

Non-technical skills (NTS) have become a cornerstone of contemporary surgical education and practice[1,2]. Beyond technical expertise, surgeons are expected to demonstrate a range of behavioral, cognitive, and interpersonal competencies that directly influence patient safety and team performance[3]. Competencies such as communication[4], leadership[5], teamwork[6], situational awareness[7], professionalism[8], and decision-making[9] have been consistently associated with reductions in adverse events and improvements in surgical outcomes. Evidence[10,11] indicates that many surgical errors are not attributable to technical incompetence but rather to deficits in non-technical skills, underscoring the need for structured approaches to assess and enhance these competencies in both training and clinical practice.

Multisource feedback has long been recognized as a valuable tool in medical education, enabling learners and practicing clinicians to identify strengths and areas for improvement[12]. In surgical contexts, however, feedback mechanisms often remain informal, fragmented, or limited to faculty evaluations[13]. Traditional learning models rely heavily on observational learning and unstructured commentary, which may fail to capture the behavioral dimensions of performance. More structured feedback approaches, including peer review, direct observation, and multisource assessments, have therefore been developed to provide reliable and actionable insights. When multisource feedback is systematic and grounded in observable behaviors, it becomes a powerful driver of deliberate practice, fostering both technical mastery and the refinement of interpersonal and professional conduct[14,15].

The application of multisource feedback (MSF), also referred to as 360-degree feedback, offers a comprehensive strategy for assessing non-technical skills in surgical education and practice[16]. By incorporating perspectives from supervisors, peers, nurses, other team members, patients, and self-assessment, MSF provides a multidimensional view of professional behavior[17]. Studies conducted across multiple countries have demonstrated the reliability, validity, and feasibility of MSF tools in assessing domains such as professionalism, communication, and collaboration[18,19]. In surgical settings, MSF has shown potential to identify performance gaps, support reflective learning, and promote behavioral changes that enhance intraoperative teamwork and patient outcomes. Nevertheless, challenges including

response fatigue, cultural resistance, and variability in instrument design persist, warranting further investigation.[16,17]

Given the growing recognition of non-technical skills as key determinants of safe and effective surgical practice, a systematic mapping of how multisource feedback has been applied to assess these competencies in surgical contexts is warranted. Although multisource feedback has been widely used in medical education, the literature specifically addressing its application to the assessment of non-technical skills in surgery remains limited and dispersed.

This study therefore aims to provide a structured mapping of the scientific literature through a bibliometric review and thematic analyses addressing the use of multisource feedback for the assessment of non-technical skills in surgical contexts. By combining bibliometric techniques with thematic analysis, this review seeks to characterize the international scientific production on the topic, identify major publication trends, and map the principal instruments used to assess non-technical competencies in surgical practice.

Bibliometric analysis offers important advantages for examining emerging research fields. First, it enables the quantification and characterization of the international scientific output on a given topic, highlighting publication trends, leading countries, specialized journals, and institutional collaboration networks. Second, it allows the identification of methodological approaches, validation strategies, and the principal multisource assessment instruments used to evaluate non-technical competencies in surgical practice.

Because the literature specifically addressing multisource feedback for the assessment of non-technical skills in surgical contexts remains limited, the present study adopts a bibliometric techniques and thematic analysis as complementary strategies to provide a structured overview of the available evidence. Despite the increasing recognition of multisource feedback as an important tool for evaluating professional competencies in healthcare, no previous study has systematically mapped the scientific literature focusing specifically on the use of multisource feedback for assessing non-technical skills in surgical contexts.

2. METHODS

This study was conducted as a bibliometric review and thematic analysis of the literature on multisource feedback for the assessment of non-technical skills in surgical

contexts. The study protocol was registered on the Open Science Framework (OSF) and published.[20] The methodological framework was structured according to the five-phase model proposed by Clemente et al. (2021)[21]. This framework comprises the following stages: (1) research design; (2) data compilation; (3) data analysis; (4) results visualization; and (5) results interpretation. Each phase is described below.

2.1 Research design

This review was guided by a problem formulation using the PCC mnemonic to ensure conceptual clarity for study selection and variable extraction. Population (P): surgeons and surgical residents. Concept (C): multisource feedback (MSF; 360-degree feedback) used to assess non-technical skills (e.g., communication, teamwork, leadership, situational awareness, professionalism, decision-making). Context (C): clinical and hospital-based surgical settings. The overarching research questions were: (i) what are the core domains related to multisource assessment of non-technical competencies in surgical practice?; (ii) which are the main research centers in the field, the authors most frequently associated with publications, the publication sources, and the key research-related terms?; and (iii) what methodological approaches and validation evidence have been reported? To address these questions, the following variables were predefined for extraction: authors, year of publication, country/region, scientific source, assessed competencies (domains), multisource assessment instruments for non-technical competencies in surgical practice, and their validation evidence. Given the limited number of studies specifically addressing multisource feedback for the assessment of non-technical skills in surgical contexts, this study combines bibliometric techniques with thematic analysis to provide a structured mapping of the available evidence. Bibliometric techniques planned *a priori* included bibliographic coupling (sources and documents) and keyword co-occurrence analysis to map the intellectual structure, thematic foci, and research frontiers.

A review design was adopted because the literature on this topic is limited, heterogeneous, and methodologically diverse. This design was considered appropriate to map the breadth of available evidence, identify the main competency domains and assessment instruments, and describe publication patterns across the field. Bibliometric techniques were

incorporated to examine structural aspects of the literature, whereas thematic synthesis was used to organize the substantive findings of the included studies.

2.2 Data compilation

Searches were conducted through March 2025 in the following bibliographic databases: BASE (Bielefeld Academic Search Engine), ProQuest, CINAHL, LILACS, Embase, MEDLINE via PubMed, SciELO, Scopus, and Web of Science (WoS). Document type was limited to primary research articles, with no regional restrictions. Eligible records met all criteria: (a) use of multisource/360-degree feedback in surgical contexts; (b) assessment of non-technical skills; (c) presence of empirical data on the intervention; (d) publication languages Portuguese, English, or Spanish; and (e) full-text availability. Secondary studies (e.g., reviews), theoretical essays without empirical data, and records without full text were excluded. Search strategies were tailored to each database using DeCS- and MeSH-mapped terms reflecting the PCC structure. The search strategy was structured using the PCC framework. Additional terms related to measurement properties were included as supplementary filters to enhance retrieval sensitivity without restricting the conceptual scope. P— doctor* OR physician* OR surgeon* OR “surgical practice” OR “surgical setting”; C (concept)— “multisource feedback” OR “multi-source feedback” OR “360-degree feedback” OR “360-degree evaluation” OR “peer feedback” OR “colleague feedback” OR MSF OR “performance feedback” AND (“non-technical skills” OR “soft skills” OR communication OR teamwork OR leadership OR professionalism OR decision-making); C (context)— “surgical practice” OR surgery OR surgical OR operating room OR “clinical setting”;Additional assessment terms (supplementary filter)— reliability OR feasibility OR validity OR effectiveness OR accuracy OR assess* OR evaluation OR measurement OR “psychometric properties” OR limitation* OR strength* OR weakness*;Records were exported to EndNote for deduplication and subsequently imported into Rayyan for screening management.

2.3 Data analysis

Data analysis comprised two complementary components. First, bibliometric analyses were performed to examine document and source relationships, keyword co-occurrence, and descriptive publication patterns. Second, a thematic synthesis was conducted to characterize the instruments, assessed competencies, and psychometric evidence reported in the included studies.

Screening was conducted in Rayyan by two independent reviewers at the title and abstract levels, with disagreements resolved by a third reviewer. Full texts of selected records were then assessed against predefined eligibility criteria. Data extraction was performed using a structured Microsoft Excel spreadsheet based on the variables established during the research design phase. To ensure accuracy and consistency in bibliometric normalization, OpenRefine was used to create a project-specific thesaurus, consolidating orthographic variants, singular and plural forms, and acronym expansions related to multisource feedback instruments. Quantitative analyses were conducted using VOSviewer and included: (i) bibliographic coupling at the document and source levels, to identify intellectual linkages and research clusters; (ii) organizational co-authorship analysis, to examine patterns of institutional collaboration; and (iii) keyword co-occurrence analysis using both author-assigned keywords and those indexed in standardized systems such as DeCS (Health Sciences Descriptors) and MeSH (Medical Subject Headings). This analytical strategy enabled a more precise delineation of thematic structures, collaboration dynamics, and emerging trends, while the use of indexed descriptors contributed to greater terminological standardization across biomedical databases. A minimum threshold of five occurrences was applied for keyword inclusion in order to reduce the influence of generic or weakly representative terms. In addition, descriptive statistics were used to summarize publication years, countries, journals, institutions, and collaboration patterns. In parallel with the bibliometric analyses, a qualitative thematic synthesis was conducted to characterize the instruments identified, the non-technical competencies assessed, and the psychometric evidence reported across the included studies.

2.4 Results visualization

Visual representations generated using VOSviewer were used to illustrate the structural and thematic dimensions of the research field. Bibliographic coupling maps at

document and source levels revealed clusters representing distinct research traditions and citation proximity. Keyword co-occurrence maps highlighted thematic clusters such as professionalism, communication, surgical education, patient safety, and residency training. In these visualizations, node size represented frequency (for keywords) or link strength (for bibliographic coupling), while spatial distance indicated conceptual relatedness between elements. Complementary tables were generated to present publication distributions by country, year, journal, and study design, as well as the frequency of assessed non-technical competencies.

3. RESULTS

The screening process began with the identification of one thousand ninety-eight records retrieved from searches across bibliographic databases. After duplicate removal, three hundred and fifty-three unique records remained for screening. Title review resulted in the exclusion of two hundred and seven records, followed by abstract screening of the remaining records, during which forty-five additional records were excluded. A total of ninety-five studies were deemed eligible for full-text review; however, five were excluded due to lack of explicit conceptual alignment, and one study identified through reference list screening was also excluded for not meeting the eligibility criteria. Ultimately, fourteen studies constituted the final analytical sample (Figure 1).

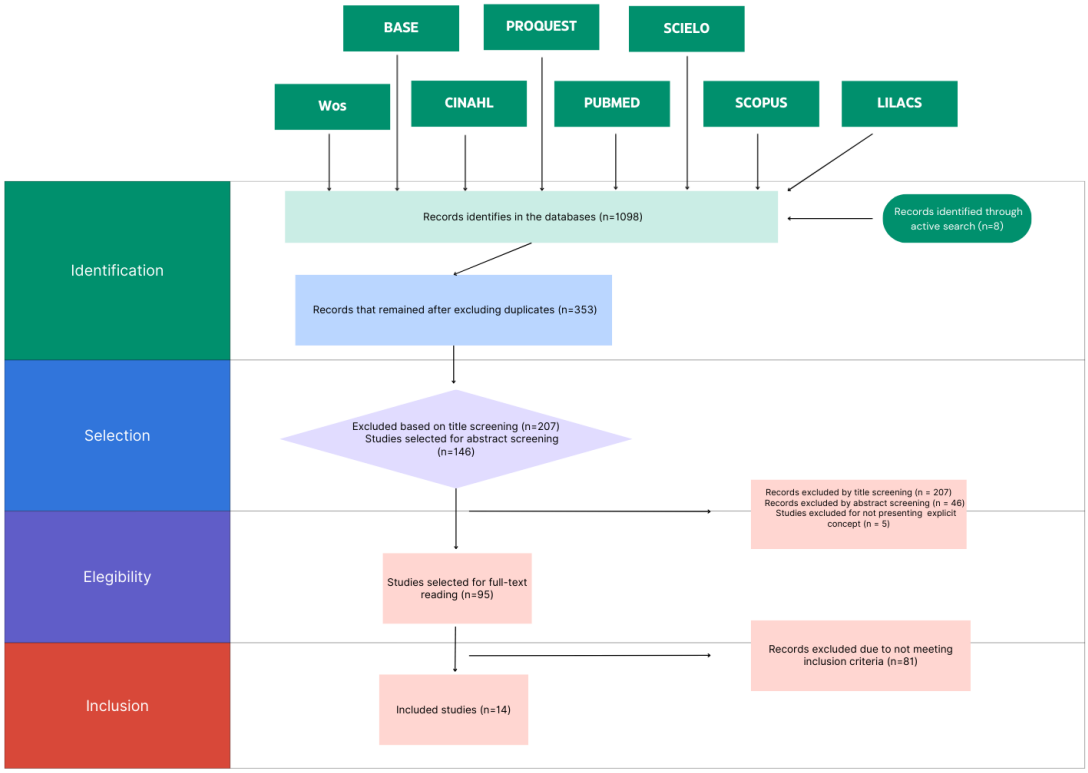

Figure 1 - Flow diagram of study selection[20]

Table 1. summarizes the characteristics of the included studies, presenting the study setting, year of publication, principal competency domains addressed, and the multisource feedback programme adopted or used as the basis for each study

Author(s) / Year / Country	MSF programme	Competencies addressed
Zhao et al.[23] (2013, China)	Instrument developed by authors	Professionalism; communication and interpersonal skills
Yazdankhah et al.[24] (2015, Iran)	ACGME competencies 360-degree assessment questionnaire (adapted)	Professionalism
Nurudeen et al.[16] (2015, USA)	PULSE programme	Professionalism; communication and interpersonal skills
Hennel et al.[25] (2020, Germany)	MSF_RG	Professionalism; communication and interpersonal skills
Fontes et al.[26] (2014, USA)	NR. MSF in neurosurgery / ACGME competencies framework	Error disclosure; risk and crisis management; leadership; professionalism; breaking bad news; behavioural components; decision-making
Lanz et al. [27](2018, USA)	PULSE 360 programme	Teamwork
Lockyer et al. [22](2012, Canada)	PAR (validated)	Communication and interpersonal skills; commitment to professional development
Crossley et al. [28](2011, United Kingdom)	NOTSS	Situation awareness; decision-making; communication; teamwork; leadership
Violato et al.[29] (2003, Canada)	PAR	Communication and interpersonal skills; commitment to professional development
Pollock et al.[30] (2007, USA)	Plastic Surgery Questionnaire	Technical/operative skills; patient care; ACGME core competencies
Higgins et al.[31] (2003, USA)	Instrument developed by authors	ACGME core competencies

Allen et al. [32](2023, Canada)	PAR as conceptual and psychometric framework	Communication; interprofessionalism; teamwork/collaboration; leadership; professionalism
Matthiesen et al. [33](2023, Denmark)	Leadership assessment questionnaire	Leadership
Soelling et al. [17](2025, USA)	NOTSS	Leadership; communication; teamwork; decision-making; situational and resource awareness

Abbreviations: MSF, multisource feedback; PAR, Physician Achievement Review; ACGME, Accreditation Council for Graduate Medical Education; PULSE, PULSE 360 Program; NOTSS, Non-Technical Skills for Surgeons; NR, not reported. *MSF_RG= Questionaire for residency training in German language*

Among the fourteen articles analyzed, six were published in the United States, accounting for 43% of the total sample. Canada followed with three publications (21%), while Germany, the United Kingdom, Denmark, China, and Iran each contributed one article (7% each). The distribution of publications by country is presented in Table 2.

Table 2. Distribution of Publications by Country

Country	Number of Publications	Percentage of Total (%)
United States of America	6	43%
Canada	3	21%
Germany	1	7%
United Kingdom	1	7%
Denmark	1	7%
China	1	7%
Iran	1	7%
Total	14	100%

Most of the analyzed articles were published within the last decade (Figure 2). Two periods of increased publication activity were observed: between 2011 and 2015 (42.9%) and again from 2023 onward (21.4%), suggesting renewed scholarly attention to the use of multisource feedback for the assessment of non-technical skills in surgical contexts

The Figure 2 describe the organizational co-authorship network, highlighting institutional collaborations in the field of multisource feedback and non-technical skills assessment in surgery. The visualization shows a strong concentration of collaborations among major academic and clinical centers located in Boston, including the Harvard School of Public Health, Massachusetts General Hospital, Brigham and Women's Hospital, Boston Children's Hospital, Beth Israel Deaconess Medical Center, Cambridge Health Alliance, and Ariadne Labs. These institutions form a highly interconnected cluster, with dense ties

reflecting frequent co-authorship and research partnerships. The inclusion of entities such as the Risk Management Foundation and regional hospitals (e.g., North Shore Medical Center and South Shore Hospital) further illustrates the integration of clinical practice settings with academic institutions. (Figure2)

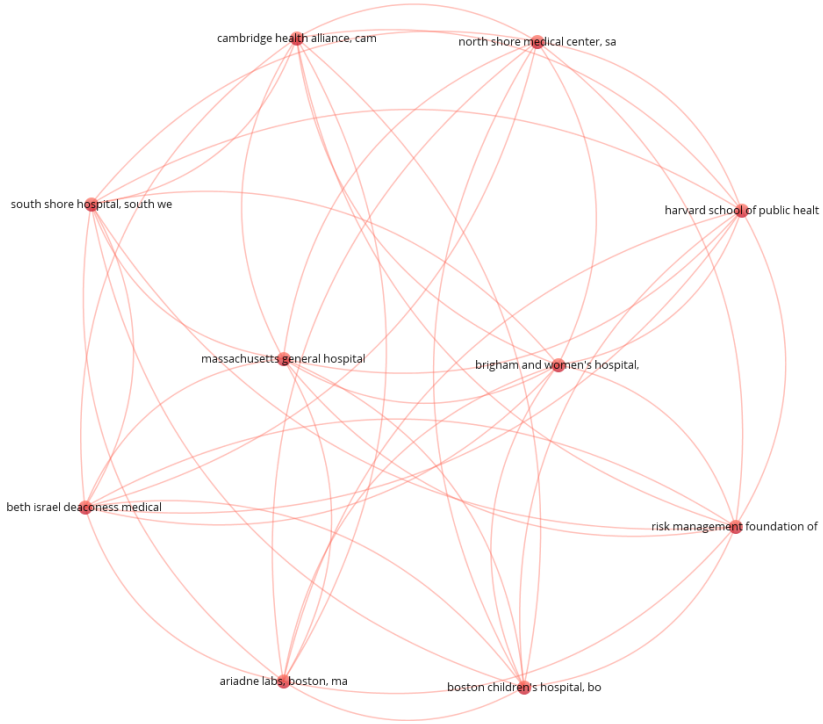

Figure 2 – Organizational co-authroship network

Among the fourteen articles analyzed, twelve distinct scientific journals were identified as publication venues, with *Medical Education* accounting for three articles (21%). This distribution indicates a moderate concentration in journals specializing in medical education and surgery, alongside a broader dispersion across outlets focused on continuing education and specific clinical practice domains (Table 3).

Table 3 – Distribution of Publications by Journal

Journal	Number of Publications	Percentage of Total (%)
Medical Education	3	21%
Journal of the American College of Surgeons	2	14%
Journal of Surgical Education	2	14%
BMC Medical Education	2	14%
British Medical Journal (BMJ)	1	7%
The Annals of Thoracic Surgery	1	7%
Annals of Surgery	1	7%

Plastic and Reconstructive Surgery	1	7%
Medical Teacher	1	7%
Danish Medical Journal	1	7%
Medical Journal of the Islamic Republic of Iran (MJIRI)	1	7%
Journal of Nursing Management	1	7%
Journal of Continuing Education in the Health Professions	1	7%
Total	14	100%

The fourteen selected articles encompassed a diversity of study types and methodologies, with a predominance of empirical research focused on the assessment of professional competencies. Methodological studies constituted the largest group, with five publications (36%), exemplified by the psychometric analyses conducted by Zhao et al.[23] and Hennel et al.[25]. This was followed by three observational studies applying 360-degree feedback tools, such as those reported by Soelling et al.[17], Nurudeen et al.[16], and Higgins et al.[31], accounting for 21% of the sample. The remaining studies (43%) comprised a heterogeneous group, including retrospective cohort analyses, qualitative investigations using mixed-methods approaches, and educational implementation studies, such as those presented by Matthiesen et al.[33]. This methodological diversity reflects the maturation of research on non-technical skills assessment and the increasing complexity of study designs applied within the health professions.

Upon examination of the keyword co-occurrence network map, the red cluster (Figure 3) emphasizes concepts such as professionalism, communication, interpersonal skills, and multisource feedback; the blue cluster is related to surgery, surgeons, 360-degree feedback, and patient care; the green cluster highlights internship and residency training, clinical competence, and curriculum; and the purple cluster is associated with healthcare professionals' attitudes and studies in anesthesiology. This network visualization illustrates the interconnections between feedback-based assessment and broader domains of surgical education, clinical competence, and professional development, while also indicating the prominence of non-technical skills, particularly communication and professionalism, as central themes in the research area.

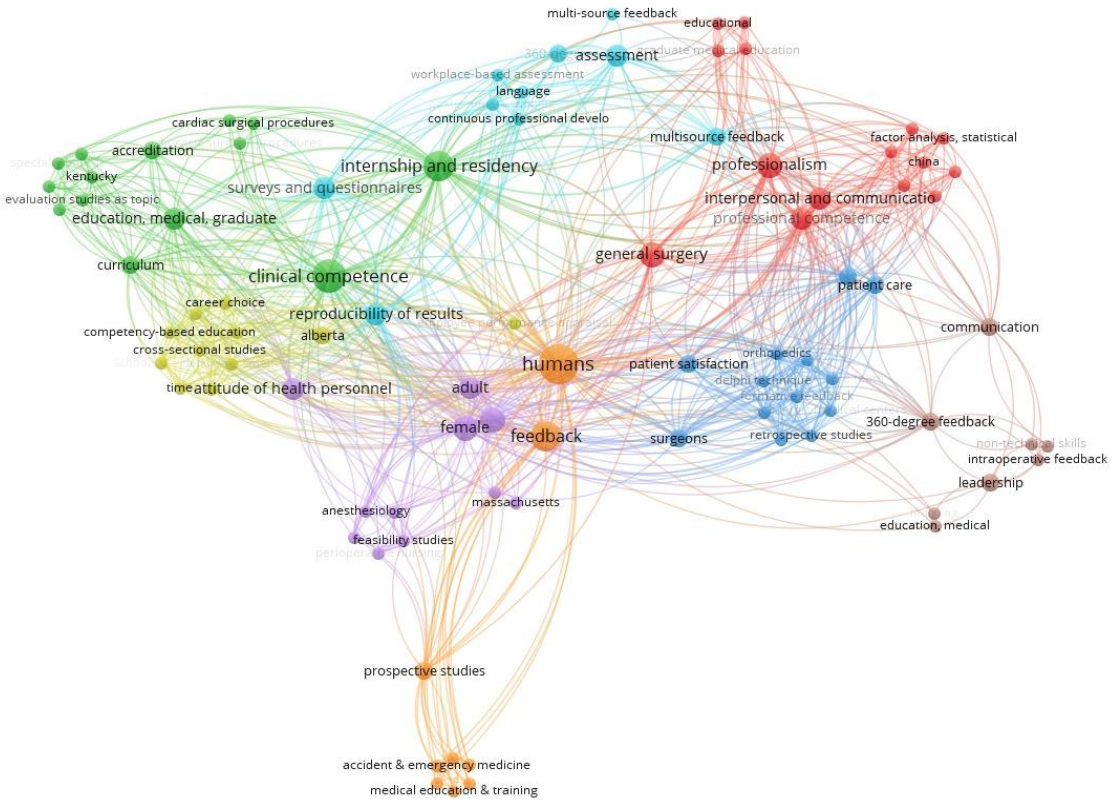

Figure 3. Network Map

Across the fourteen included articles, twelve distinct non-technical skill domains were identified as targets of multisource feedback interventions in surgical contexts (Table 4). Communication and interpersonal skills were the most frequently reported domain, appearing in 11 studies (78.6%), followed by professionalism, which was reported in 7 studies (50.0%). Leadership and teamwork were identified in 5 (35.7%) and 4 (28.6%) studies, respectively, whereas decision-making appeared in 3 studies (21.4%). This distribution indicates the predominance of communication, interpersonal skills, and professionalism in the assessment of surgical competence, while also highlighting the growing attention given to leadership, teamwork, and decision-making as relevant non-technical domains in surgery. Because individual studies could address more than one competency domain, the frequencies presented in Table 4 are not mutually exclusive and should not be interpreted as summing to the total number of included studies.

Table 4. Main Non-Technical Skills Addressed Through Feedback in Surgery

Non-technical skill	Occurrence	%
Communication and interpersonal skills	11	85,7

Profissionalism	7	50,0
Leadership	5	35,7
Decision making	3	21,4
Teamwork	4	28,5
Commitment to professional development	2	14,2
Situational awareness / Awareness of situation and resources	2	14,2
Behavioral components	1	7,1
Error disclosure	1	7,1
Risk and crisis management	1	7,1
Breaking bad news	1	7,1
Technical/operational skills, patient care, and ACGME general competencies	1	7,1

The assessment of non-technical competencies has become an essential component of surgical training and practice. In this context, multisource feedback (MSF) instruments play a central role in comprehensively measuring these dimensions. However, the effectiveness of MSF depends on the psychometric quality of the instruments employed, which requires robust validation processes and reliability analyses. Psychometric validation encompasses the process of determining whether an instrument measures, in a consistent and appropriate manner, the construct it is intended to assess. The psychometric literature identifies multiple forms of validity (content, construct, criterion, and face validity) as well as measures of reliability, which ensure the legitimacy of inferences drawn from assessment scores. (Table 5). Review of the analyzed studies demonstrates widespread use of factor analysis, Cronbach's alpha, intraclass correlation coefficients (ICC), and generalizability theory.

Overall, the consolidated results indicate high levels of psychometric consistency, with Cronbach's alpha values ranging from 0.79 to 0.97, alongside the use of diverse validation methods.

Table 5. Modes of Evaluation Validation of the Instruments Used in the Reviewed Articles

Author(s) (year)	Instrument evaluation mode	Instrument / Psychometric theoretical basis	Main statistical method
Violato et al.[29] (2003)	Reliability; Face, content, and construct validity	PAR	Expert committee; Cronbach's alpha (0.93–0.97); Generalizability coefficient; Exploratory factor analysis
Higgins et al.[31] (2004)	Face and content validity	Instrument based on ACGME competencies	Expert committee; literature review; pilot testing; descriptive analysis
Lockyer et al.[22] (2012)	Response process; Reliability; Construct validation	PAR	Response rate; mean score; Cronbach's alpha (>0.90); Generalizability coefficient; Factor analysis
Crossley et al.[28] (2011)	Feasibility; Reliability; Construct validity; Correlation between scores and performance	NOTSS	Generalizability coefficient (>0.80); Exploratory factor analysis; Pearson correlation
Soelling et al.[17] (2025)	Content; Construct; Use	NOTSS	Expert review; qualitative methodologies; descriptive statistical analysis
Allen et al.[32] (2023)	Content, face, use, and construct validity	Instrument derived from PAR	Expert panel; thematic analysis; Mann–Whitney U test; interquartile range
Matthiesen et al.[33] (2023)	Content; Construct; Reliability	MSF for medical leadership	Qualitative thematic analysis; rater triangulation
Lanz et al.[27] (2018)	Reliability; Content validity	PULSE 360°	Cronbach's alpha (>0.70); descriptive statistics
Hennel et al.[25] (2020)	Content; Response process; Internal structure; Consequences	MSF_RG	Think-aloud; exploratory factor analysis; Cronbach's alpha (0.93–0.95); Generalizability coefficient
Yazdankhah et al.[24] (2015)	Content; Feasibility; Reliability	ACGME competencies 360° (adapted)	Translation/back-translation; response rate; Cronbach's alpha (0.88)
Pollock et al.[30] (2008)	Content; Validity; Differentiation among rater groups	MSF Short Form	Hierarchical clustering; Kruskal–Wallis; analysis of covariance
Fontes et al.[26] (2014)	Content, face, and use validity	MSF in neurosurgery	Expert review; curricular alignment; participant acceptance
Nurudeen et al.[16] (2015)	Content; Perceived accuracy; Construct validity	PULSE 360	Agreement index; 95% CI; correlation between domains
Zhao et al.[23] (2013)	Content; Reliability; Construct validity	Author-developed instrument	Agreement rate; Cronbach's alpha (0.86–0.93); Exploratory factor analysis

Prepared by the authors, 2025. Legend: ICC – Intraclass Correlation Coefficient, an indicator of inter-rater reliability. The table presents the types of psychometric validation employed in the 14 analyzed studies, highlighting the statistical methods and instruments used as theoretical or methodological bases. Validations include measures of internal consistency (Cronbach's alpha), content validity, construct validity, and criterion validity.

The bibliometric and thematic analyses provided an overview of the scientific literature addressing multisource feedback for the assessment of non-technical skills in surgical contexts.

The results revealed a strong geographic concentration of research in North America, particularly in the United States and Canada. Two periods of increased publication activity were observed: between 2011 and 2015 and again from 2023 onward.

Analysis of the co-authorship network highlighted the central role of academic and clinical institutions based in Boston, which formed a dense and collaborative cluster. Journal analysis demonstrated a moderate concentration of publications in outlets specializing in medical education and surgery, alongside a broader dispersion across journals focused on clinical practice and professional education.

Regarding the competencies assessed, communication and interpersonal skills and professionalism were the most frequently reported non-technical skills across the included studies. Leadership, decision-making, teamwork, and commitment to professional development were also identified among the assessed domains, whereas situational awareness, error disclosure, and crisis management appeared less frequently.

Taken together, the bibliometric review and thematic analyses indicated that the literature on multisource feedback for non-technical skills in surgery remains limited, geographically concentrated, and methodologically heterogeneous.

4. DISCUSSION

Overall, the findings of this review provide a structured overview of the scientific literature addressing the use of multisource feedback (MSF) for the assessment of non-technical skills in surgical contexts. The results indicate that research in this field remains relatively limited and geographically concentrated, with the majority of studies originating from North America and other high-income settings. At the same time, the thematic clusters identified through bibliometric analysis highlight the growing recognition of multisource feedback as a relevant approach for assessing behavioral and interpersonal competencies that are essential for safe surgical practice.

Within the literature retrieved through the search strategy applied in this review, no studies originating from Latin American countries were identified, suggesting a potential geographic gap in the current body of evidence on multisource feedback for the assessment of non-technical skills in surgical contexts. This observation may reflect disparities in research capacity, publication visibility, or the adoption of structured feedback systems within surgical training programs across different regions. These findings point to the need for greater diversification of research settings and for studies exploring the implementation and evaluation of multisource feedback in underrepresented regions. Expanding research in diverse cultural and educational contexts may contribute to a more comprehensive understanding of how non-technical competencies are assessed and developed within surgical training programs.

This review achieved its objective by mapping the literature on the use of multisource feedback for the assessment of non-technical skills in surgical contexts and by characterizing the principal instruments, competency domains, and validation approaches reported across the included studies. The bibliometric analyses contributed to understanding publication patterns, collaboration structures, and thematic clustering, while the thematic synthesis supported interpretation of the substantive content of the field. In addition, the review highlighted the prominence of communication and professionalism among the non-technical competencies assessed, while also identifying recurrent domains such as leadership, decision-making, teamwork, and commitment to professional development.

The predominance of contributions originating from North America is illustrated by studies analyzing longitudinal data from Canadian surgeons through structured multisource feedback programs[14,22], as well as investigations exploring the catalytic effects of MSF among residents and clinical team leaders[32]. Seminal studies involving Canadian physicians also corroborated psychometric validation efforts for assessment instruments in this region[27]. In the United Kingdom, investigations examining the implementation of multisource feedback in teaching hospitals, with particular attention to non-technical skills in the operating room, were particularly notable[28]. Contributions from Germany demonstrated the application of German-language feedback instruments, reinforcing the relevance of cultural adaptation in assessment processes[25].

The predominance of journals such as *Medical Education* and the *Journal of Surgical Education* reflects growing institutional interest in formalizing the assessment of professional competencies within medical training. Studies evaluating surgeons' performance using multisource feedback emphasized the psychometric robustness of this approach and advocated its systematic adoption in professional assessment[22,29]. Similarly, research conducted in non-English-speaking contexts demonstrated the reliability and applicability of MSF for assessing professionalism among surgical residents[24]. Other studies confirmed the validity of instruments applied across diverse cultural contexts, highlighting their contextual appropriateness and their capacity to capture interpersonal and professional competencies[23]. Additional investigations reinforced the importance of alignment between assessment content, feedback processes, and local training contexts[25].

The diversity of study designs and publication types reflects distinct strategies for evaluating and promoting professional competencies in surgical education, with particular emphasis on leadership, communication, and interpersonal skills. The prevalence of methodological and psychometric validation studies indicates a consolidated demand for robust instruments adaptable to different contexts[22,29]. The use of 360-degree feedback as a central assessment approach has intensified, demonstrating its utility in capturing aspects of professional performance that extend beyond strictly technical domains[16,31]. However, these studies also identified challenges related to institutional acceptance, rater engagement, and the integration of multisource feedback into educational processes. At the same time, the increasing use of qualitative and mixed-methods approaches suggests growing interest not only in measuring competencies but also in understanding learning mechanisms, perceived barriers, and the educational impact of feedback in complex surgical environments[27,33].

The recurrence of communication across nearly all analyzed articles reinforces its centrality in contemporary surgical practice, encompassing both patient interactions and interpersonal communication with colleagues and multiprofessional teams. Studies highlighted communication and teamwork as core elements of professional excellence frameworks, demonstrating their correlation with broader indicators of professional behavior[16]. Similarly, assessments conducted through 360-degree feedback included items related to effective and sensitive patient communication, respect for

socioeconomic diversity, and interpersonal conflict resolution[24]. Other investigations emphasized professionalism, ethics, and responsible conduct, proposing specific assessments for attributes such as punctuality, reliability, and task completion[23].

Taken together, these findings underscore the growing recognition of non-technical skills as structural components of contemporary surgical practice. The recurrent inclusion of attributes such as empathy, self-reflection, humility, and transformational leadership reflects a paradigm shift in which technical performance, although essential, is insufficient to define professional excellence. Formative multisource assessment appears particularly relevant for capturing behavioral nuances, fostering self-awareness, and supporting continuous professional development. This perspective aligns with the educational objectives of international surgical training frameworks and widely recognized competency models[14,22].

Analysis of the eligible studies further indicates that, in most cases, the behavioral competencies assessed were not originally proposed by individual studies but derived from previously established and internationally validated frameworks. These external models exerted a decisive influence on competency selection and structuring, conferring institutional legitimacy and alignment with internationally recognized standards of medical training. A paradigmatic example is the development and application of instruments grounded in previously systematized non-technical skills frameworks inspired by principles of aviation safety and human factors management[28].

Complementarily, recent evaluations of multisource feedback among surgical team leaders were grounded in competency-based educational models that establish explicit training milestones and include domains such as crisis communication, leadership, and multiprofessional collaboration[32]. Thus, even when minor adaptations are proposed, the conceptual foundations of assessed competencies remain anchored in pre-existing and internationally recognized MSF frameworks.

Studies applying standardized instruments across different surgical specialties confirmed that behaviors such as situational awareness, decision-making, communication, and leadership had already been systematized through interdisciplinary analyses conducted by reference institutions[28]. Accordingly, the reviewed articles reinforce that instruments used to assess behavioral competencies are largely grounded

in robust external frameworks adapted to surgical contexts, rather than representing isolated developments within individual studies.

The findings of this review have important implications for surgical education. By identifying the most frequently assessed non-technical competencies and the instruments currently used to evaluate them, this study contributes to informing curriculum design, assessment strategies, and faculty development initiatives aimed at strengthening competency-based surgical training.

Despite its strengths, this review has limitations. The included studies were heterogeneous with respect to study designs, populations, and instruments employed, which constrains the strength of possible inferences. In addition, the relatively small number of eligible studies reflects the emerging nature of this research field rather than limitations of the search strategy, reinforcing the need for further empirical investigations on multisource assessment of non-technical competencies in surgical practice.

Furthermore, future investigations should prioritize the cross-cultural adaptation, validation, and implementation of multisource feedback instruments in different healthcare and educational environments. Strengthening the methodological rigor and contextual applicability of these assessment tools may support their broader integration into competency-based surgical training and professional development.

5. CONCLUSION

This bibliometric review and thematic analyses, mapped a still limited but relevant body of literature on the use of multisource feedback for assessing non-technical skills in surgical contexts.

By integrating bibliometric network analyses with thematic synthesis, this review maps a field of research that remains geographically concentrated in North America and other high-income settings, largely structured around specialized journals in medical and surgical education and dense institutional collaborations. At the same time, the findings reveal important gaps, particularly regarding the cultural adaptation and implementation of multisource feedback instruments in underrepresented regions, including Latin American contexts.

Collectively, these results support the systematic incorporation of multisource feedback into competency-based surgical education and quality improvement initiatives. Future research should prioritize instrument standardization, cross-cultural validation, clearer reporting of psychometric evidence, and robust implementation strategies capable of linking improvements in non-technical competencies to meaningful educational and clinical outcomes. Ultimately, strengthening the assessment and development of these competencies through structured multisource feedback may contribute to safer surgical practice and to the continuous improvement of the quality of patient care.

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