



NON-PHARMACOLOGICAL INTERVENTIONS FOR PAIN MANAGEMENT IN PALLIATIVE CARE PATIENTS: A LITERATURE REVIEW

Sugiono*, Wastu Adi Mulyono

Master of Nursing Student, Faculty of Health Sciences, Universitas Jenderal Soedirman, Jl dr. Soeparno, Grendeng,
Kecamatan Purwokerto Utara, Kabupaten Banyumas, Jawa Tengah 53122, Indonesia

*sugiono031@mhs.unsoed.ac.id

ABSTRACT

Family members waiting during surgical procedures often experience anxiety due to uncertainty and limited access to information. The rapid development of digital health technologies provides opportunities to support family-centered perioperative care, yet the global research landscape on this topic remains unclear. This study aimed to map global research trends, identify major research themes, and explore research gaps related to digital applications for reducing family anxiety in operating room waiting areas. A bibliometric analysis was conducted using publications retrieved from PubMed, Crossref, and Google Scholar published between January and June 2026. A total of 752 records were identified, comprising PubMed (n = 199 results), Crossref (n = 412 results), and Google Scholar (n = 141 results). After duplicate removal and screening according to the PRISMA 2020 guidelines, 8 publications were included in the final bibliometric analysis. The selected records were analyzed using VOSviewer version 1.6.20 to examine keyword co-occurrence, network visualization, overlay visualization, density visualization, as well as the most productive authors and contributing countries. The analysis identified four major research clusters, including perioperative and operating room management, mental health and family well-being, evidence-based interventions, and perception and qualitative experience. Overlay visualization revealed a shift in research trends from technical operating room management toward mental health and family-centered care. Density visualization showed that studies remain concentrated on perioperative services and patient care, whereas digital applications for family anxiety reduction are still limited. The most productive authors and contributing countries demonstrate strong multidisciplinary and international collaboration, although research specifically focusing on digital interventions for family anxiety remains scarce. Research on digital applications for reducing family anxiety in operating room waiting areas is still emerging. The integration of digital health, family-centered perioperative care, and psychological support represents an important research gap and offers significant opportunities for future innovation. Developing digital applications to provide education, communication, and emotional support for families may contribute to improving perioperative healthcare services.

Keywords: bibliometric analysis; digital health; family anxiety; family-centered perioperative care; operating room waiting area; VOSviewer

How to cite (in APA style)

Sugiono, S., & Mulyono, W. A. (2026). Global Research Trends on Digital Applications for Reducing Family Anxiety in Operating Room Waiting Areas: A Bibliometric Analysis. *Indonesian Journal of Global Health Research*, 8(5), 1247–1260. <https://doi.org/10.37287/ijghr.v8i5.2514>.

INTRODUCTION

Family anxiety is one of the psychological responses frequently experienced when a family member undergoes surgery (Howe et al., 2021a; Najout et al., 2026). Uncertainty regarding the patient's condition, the risks associated with the surgical procedure, the limited information received, and the length of time spent waiting in the operating theatre can increase levels of anxiety and stress among family members (Adugbire et al., 2025; Barberi, 2015). These conditions not only impact the family's psychological well-being but may also affect their ability to provide emotional support to the patient during the perioperative period. With the development of the concept of family-centred care, family involvement in the healthcare process is increasingly being recognised as a vital component in enhancing the quality of nursing care and patient satisfaction (Enfermería et al., 2023). Consequently, there is a need for innovative strategies to help families manage their anxiety whilst awaiting the surgical procedure.

Advances in information technology and digital health have opened up new opportunities for the delivery of psychological interventions and health education. Various innovations such as mobile health (mHealth), preoperative education apps, telehealth, virtual reality, surgical progress notification systems, and communication apps between families and healthcare professionals have begun to be implemented across various healthcare services (Linjun et al., 2025a). These technologies are considered capable of improving access to information, enhancing communication, and providing emotional support to users more effectively and efficiently. In the context of perioperative care, digital applications have the potential to serve as a medium that can help families obtain information regarding the stages of surgery, updates on the patient's condition, and relaxation techniques to reduce anxiety (Sawicki et al., 2024). However, the use of digital applications specifically designed to reduce family anxiety in the operating theatre waiting area has yet to be widely developed or researched.

The results of the bibliometric analysis indicate that research in the perioperative field has so far focused primarily on aspects of operating theatre management, patient safety, and improving the quality of care. Density visualisation shows that keywords such as 'operating room', 'patient', 'care', and 'mental health' have high density levels, indicating that these themes have been the main focus of various studies (Chiu et al., 2023). On the other hand, keywords related to family, psychological support, and digital applications still have relatively low density. These findings suggest that research on the integration of digital technology to support family mental health in the perioperative setting remains limited. This situation indicates a significant opportunity to develop application-based innovations to support more comprehensive care.

In addition to providing an overview of dominant research themes, bibliometric analysis can also be used to map the development of scientific knowledge within a specific field (Passas, 2024). Through this approach, researchers can identify publication trends, developments in research topics, the productivity of authors and institutions, patterns of collaboration between researchers, and the most frequently used keywords. Bibliometric analysis is also capable of revealing research areas that have developed well as well as those that still have research gaps. This information is crucial for determining the direction of future research so that it can yield innovations with high novelty and scientific contribution (Kumar et al., 2024; Marzi et al., 2025). Thus, bibliometrics serves not only as a tool for mapping the literature but also as a foundation for formulating research strategies relevant to the advancement of science.

Based on the results of the bibliometric mapping, it can be concluded that research into digital applications for reducing anxiety among families in operating theatre waiting areas remains a relatively new and under-explored field. Most existing research still focuses on patients as the recipients of interventions, whilst families as part of family-centred perioperative care have not yet been a primary focus. In fact, families play a crucial role in supporting the patient's healing process and often experience significant psychological strain whilst the surgical procedure is underway. The integration of application technology, mental health support, and perioperative care has the potential to become an innovative research direction aligned with current developments in digital health. Therefore, this bibliometric analysis aims to examine global research trends regarding the use of digital applications to reduce family anxiety in operating theatre waiting areas, whilst identifying opportunities for future research development.

METHOD

Study Design

This study employs a bibliometric analysis design with a quantitative approach to map the development of research on the use of mobile applications to reduce family anxiety in operating theatre waiting rooms. The bibliometric analysis was conducted to identify publication trends,

collaboration patterns, relationships between keywords, as well as emerging research themes and research gaps.

Data Sources and Search Strategy

Data for this study were obtained from three scientific databases, namely PubMed, Crossref, and Google Scholar, which were selected to ensure a broad coverage of the literature on the use of applications to reduce family anxiety in operating theatre waiting rooms. The search for articles was conducted on publications released between 2005 and 2026 using a combination of keywords and Boolean operators covering aspects of digital applications such as mobile application, digital application, mHealth, telehealth, smartphone application, and virtual reality, as well as family anxiety, caregiver anxiety, family stress, and psychological distress), and perioperative care (operating room, surgery waiting room, perioperative care, and surgical waiting area).

Inclusion & exclusion criteria

The articles analysed were English-language publications released between 2005 and 2026 in the form of original research articles and review articles, focusing on the use of digital applications to reduce family anxiety in the perioperative context or operating theatre. Articles in the form of editorials, letters to the editor, conference abstracts, duplicate articles, those with incomplete metadata, and articles irrelevant to the research objectives were excluded from the analysis. The application of these criteria aims to ensure that the data used is of high quality and highly relevant to the research focus.

Data analysis

Data analysis was conducted using VOSviewer version 1.6.20 to map the structure and development of research on the application of interventions to reduce anxiety among families in operating theatre waiting rooms. The analyses employed included co-occurrence of keywords to identify relationships and groupings of keywords that frequently appear together, co-authorship to analyse patterns of collaboration between authors, co-citation to identify links between references that are frequently cited together, and bibliographic coupling to determine relationships between articles based on similarities in the reference lists used. The results of the analysis were visualised in the form of network visualisations, overlay visualisations, and density visualisations to depict the research network, the development of topics over time, and the density of research within each theme. This approach was used to identify research trends, dominant themes, and research gaps that could form the basis for future studies.

PRISMA Flowchart

The selection of articles for this study followed the PRISMA 2020 guidelines. Articles were identified from three databases, namely PubMed, Crossref and Google Scholar, and duplicate articles were removed. Subsequently, articles were screened based on their titles and abstracts, and evaluated through a full-text review in accordance with the inclusion and exclusion criteria. Articles meeting all requirements were included in the bibliometric analysis and analysed using VOSviewer. This process was carried out to ensure transparency and validity in the selection of research literature.

RESULT

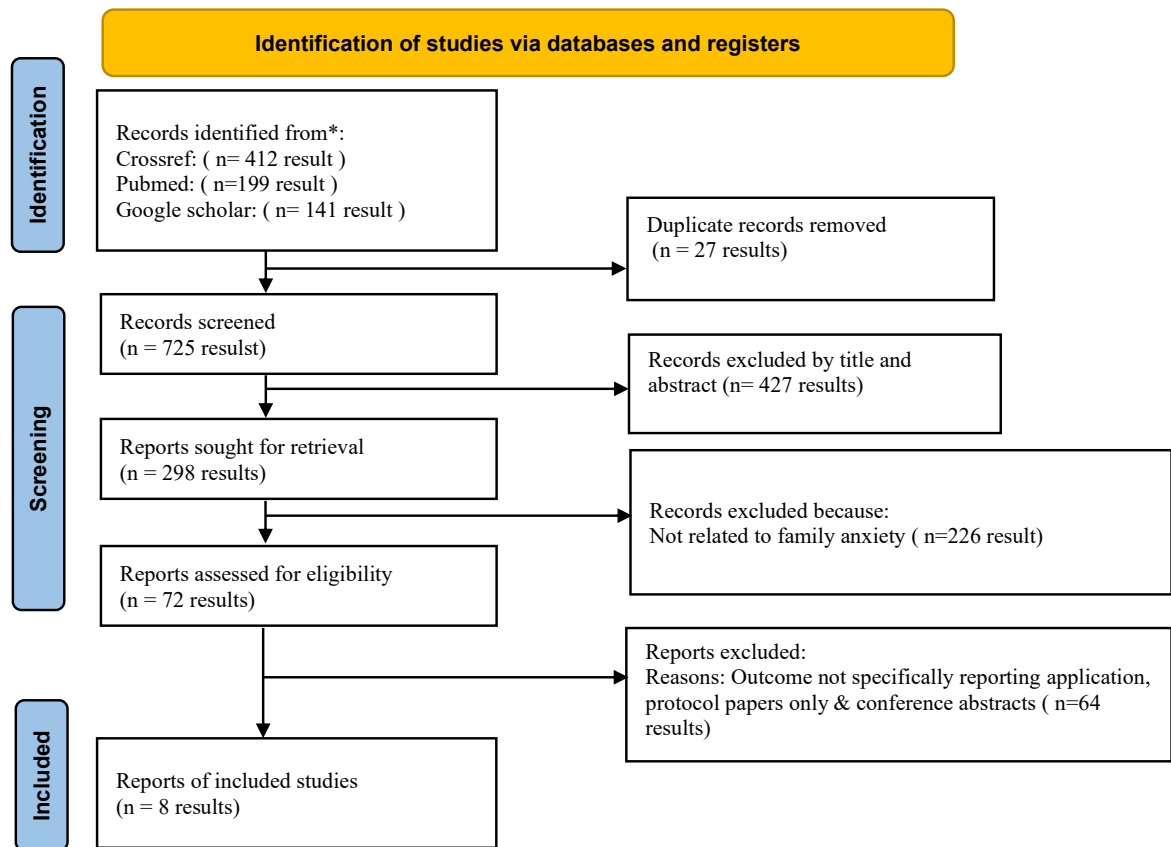


Figure 1. Prisma flowchart

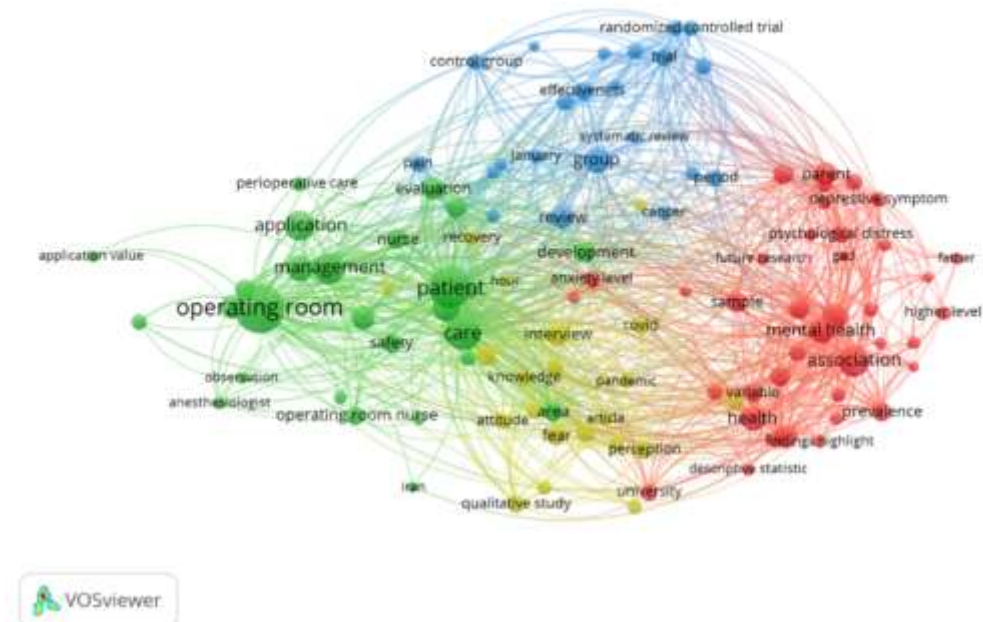


Figure 2. Network visualizatin

The results of the keyword co-occurrence analysis using VOSviewer identified four main clusters that describe the intellectual structure of research on applications, perioperative care, and family anxiety. The formation of clusters was based on the frequency of keywords appearing together in

the publications analysed. In general, research is still dominated by themes such as operating theatre services, mental health, the effectiveness of interventions, and the perceptions and experiences of patients and their families. However, keywords specifically related to mobile applications, smartphone applications, or digital interventions have not yet emerged as dominant themes. These findings suggest that the use of digital applications to reduce family anxiety in operating theatre waiting rooms remains a relatively new field of research with significant potential for development. Cluster 1 (Green) focuses on the themes of perioperative care and operating theatre management, with key terms such as operating room, patient, application, management, care, nurse, safety, perioperative care, and anaesthesiologist. This cluster indicates that the majority of research is directed towards improving the quality of care, patient safety, and operating theatre management (Marais & Downing, 2022; Pourdél et al., 2026). The term 'operating room' has the largest node size, making it the centre of the research network. The strong connections between patient, care, and management indicate that a patient-centred care approach still dominates research in the perioperative field (Kuizon-Damasco & Valledor-Pasamonte, 2026; Rarani, 2025; Yie et al., 2025). Although the term 'application' has appeared in this cluster, its use is still more closely associated with service management aspects than with psychological interventions for families.

Cluster 2 (Red) addresses the theme of mental health and psychological well-being within families, comprising keywords such as mental health, psychological distress, depressive symptoms, anxiety, association, prevalence, parent, and father. This cluster indicates a growing focus on the psychological impact experienced by families or carers during the care process. The presence of the keywords 'parent' and 'father' confirms that families are beginning to be recognised as an important subject in health research (Elger et al., 2020; Kerimaa et al., 2024). However, existing research still focuses more on epidemiological aspects and mental health in general rather than specific interventions to reduce family anxiety in the operating theatre waiting area. The link between this cluster and the perioperative care cluster suggests that the psychological condition of families is closely related to their experience during the surgical process (Griffiths et al., 2024).

Cluster 3 (Blue) relates to evidence-based practice and intervention evaluation, characterised by the keywords 'randomised controlled trial', 'effectiveness', 'control group', 'systematic review', 'trial' and 'review'. This cluster indicates that research in this field frequently employs experimental and evaluative designs to assess the effectiveness of an intervention (Pourdél et al., 2026; W. Xie et al., 2023). The dominance of these keywords indicates that efforts to reduce anxiety have been extensively studied using robust scientific approaches. However, the types of interventions examined do not yet specifically focus on the use of digital applications for patients' families. This suggests an opportunity to develop technology-based intervention research supported by research designs with a high level of evidence.

Cluster 4 (Yellow) covers the themes of perception, experience and qualitative approaches, with keywords such as fear, perception, interview, qualitative study, attitude and knowledge. This cluster indicates that a number of studies seek to understand the subjective experiences of patients and their families during the perioperative process (Enfermería et al., 2023; Howe et al., 2021). Qualitative approaches are used to explore the perceptions, information needs, and emotional responses of families whilst waiting for their family members to undergo surgery. This information forms a crucial basis for the development of interventions that are better suited to users' needs (Griffiths et al., 2024). Overall, the results of the keyword mapping indicate that the integration of perioperative care, family mental health, and digital applications has not yet been extensively explored, thereby opening up new research opportunities regarding the development of applications to reduce family anxiety in operating theatre waiting rooms.

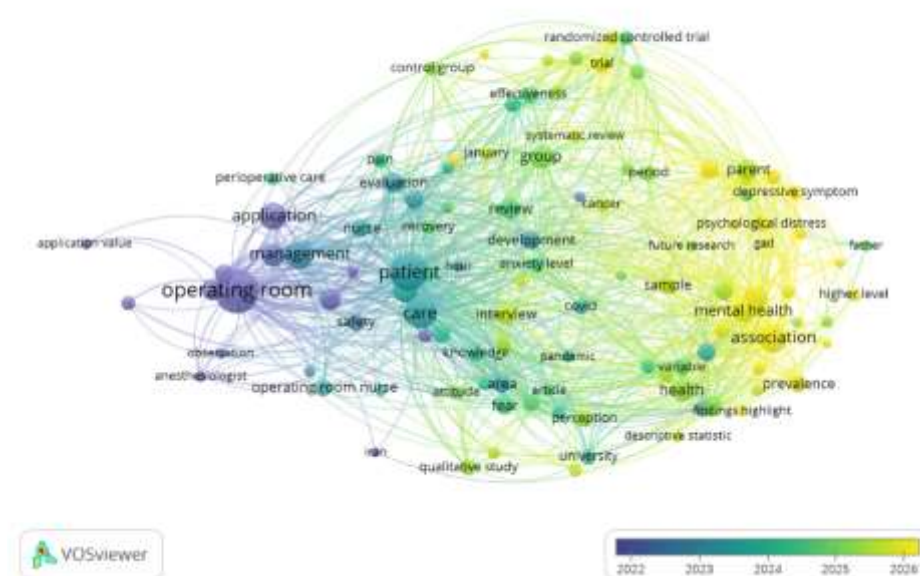


Figure 3. Overlay visualization

The results of the overlay visualisation show the development and shifting focus of research on applications, perioperative care and family anxiety over time. In this visualisation, the colour of the nodes represents the average year of publication, where blue indicates topics that have been studied for a long time, green indicates emerging themes, and yellow indicates the latest research topics (emerging topics). Overall, this map illustrates that research has evolved from the technical aspects of operating theatre services towards a greater focus on the mental health and psychological well-being of families.

Topics falling within the ‘mature research areas’ category are indicated by blue to purple nodes, such as operating theatre, application, management, anaesthetist, observation, and operating theatre nurse (Pai et al., 2026; Winterberg et al., 2024). These themes have long been the focus of research and relate to the organisation of operating theatre services, perioperative management, and improvements in the quality and safety of care. The high frequency of these keywords indicates that the technical and operational aspects of the operating theatre have developed well and form the foundation for subsequent research.

The green nodes represent emerging themes, including patient, care, development, effectiveness, evaluation, recovery, qualitative study, fear, and perception. The emergence of these keywords indicates that research is beginning to shift from management aspects towards evaluating the effectiveness of interventions and the experiences of patients and their families during the perioperative process (Akortiakuma et al., 2022; Najout et al., 2026; Salphale et al., 2026). Furthermore, qualitative approaches are increasingly being used to understand the needs, perceptions, and emotional responses of families. This development reflects the growing importance of an approach focused on the quality of care and the patient and family experience.

Meanwhile, the yellow nodes represent emerging topics, such as mental health, parent, depressive symptoms, psychological distress, association, prevalence, future research, and randomised controlled trials. These findings suggest that researchers’ attention is beginning to shift towards aspects of family mental health and the psychological impacts that arise during the surgical process. The association between the keywords ‘psychological distress’ and ‘parent’ suggests that families are increasingly viewed as a vital component of healthcare services requiring emotional support.

Furthermore, the emergence of the keyword ‘future research’ suggests that this field still holds significant potential for further development.

One key finding from the overlay visualisation is the position of the keyword ‘application’, which has a relatively high frequency of occurrence but is still dominated by blue-green hues and does not yet have a strong association with recent topics such as mental health and parenting. This suggests that the use of applications in research to date has been focused more on aspects of operating theatre management and services rather than as an intervention to reduce family anxiety. Consequently, the integration of digital applications, family mental health, and perioperative care has yet to be fully explored. These findings highlight a research gap that could form the basis for further research into digital applications designed to reduce family anxiety in operating theatre waiting areas as part of a family-centred perioperative care approach.

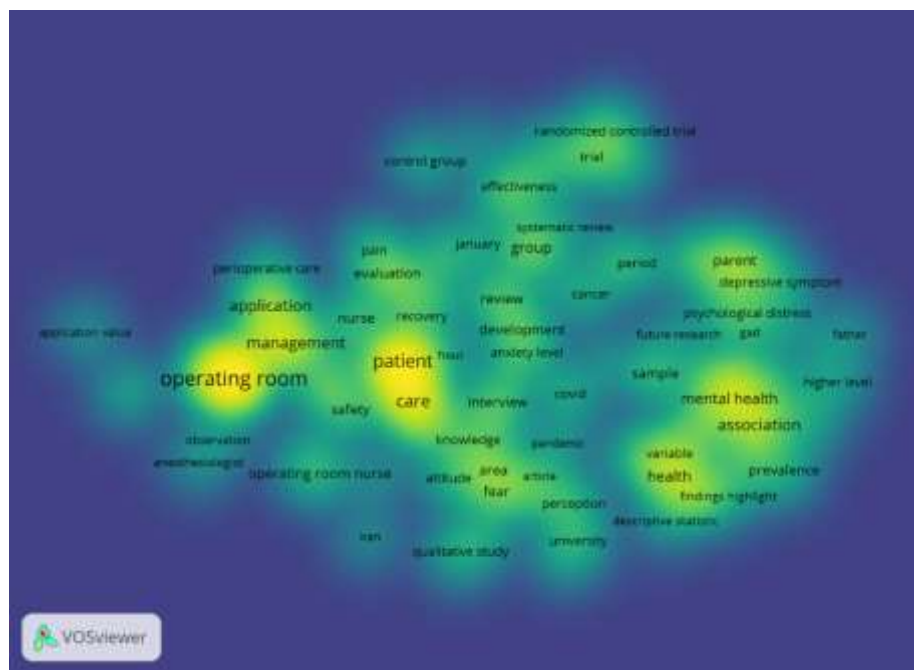


Figure 4. Density visualization

The density visualisation results show the density and intensity of research based on frequency of occurrence and the relationships between keywords in the analysed dataset. In this visualisation, yellow indicates topics that have been extensively researched (high-density areas), green indicates topics with moderate research intensity, whilst blue indicates themes that have been relatively little explored. The brighter the colour of a node, the greater the level of attention researchers have paid to that topic. Based on the analysis results, it is evident that research on applications, perioperative care, and mental health has several main centres of density that form the research structure in this field.

The areas with the highest density are dominated by the keywords ‘operating room’, ‘management’, ‘application’, ‘patient’, ‘care’ and ‘mental health’. The high frequency of these keywords indicates that research to date has largely focused on the management of operating theatres, improving the quality of care, patient safety and mental health in general (Suchodolska & Senkus, 2022). The close relationship between the keywords ‘patient’ and “care” also suggests that the patient-centred care paradigm remains a key focus in the development of perioperative care. Furthermore, the presence of the keyword ‘application’ in high-density areas indicates that technology has been widely implemented to support the management and operations of healthcare services (Chen et al., 2026). However, the use of these applications is still primarily directed towards service delivery rather than as a psychological intervention for patients’ families.

In the area of moderate density, there are several keywords such as parent, psychological distress, interview, knowledge, fear, development, review, evaluation, recovery, and effectiveness. The emergence of these keywords indicates that research is beginning to move towards a deeper understanding of the experiences and psychological conditions of both patients and their families. Topics concerning psychological distress and parents indicate that families are beginning to be included in health research, particularly regarding the emotional impact arising during the care process. Furthermore, the presence of the keywords ‘evaluation’ and ‘effectiveness’ indicates increasing efforts to assess the effectiveness of various interventions in improving the quality of care. Nevertheless, the theme of the family has not yet become a primary focus compared to patient-oriented research.

Meanwhile, several keywords such as ‘application value’, ‘anaesthesiologist’, ‘operating room nurse’, ‘qualitative study’, ‘observation’, and a number of other specific topics remain in areas of low density. The low intensity of these themes suggests that research on the use of applications as psychological interventions remains limited. Similarly, the involvement of healthcare professionals and qualitative approaches in supporting families whilst they wait for surgery have not been extensively explored. This situation indicates that there remains significant scope for developing research that integrates digital technology with nursing care and psychological support for families.

Overall, the results of the density visualisation indicate that research in this field is still dominated by themes relating to operating theatre services, patient care and mental health, whilst the integration of digital applications with the reduction of family anxiety in the operating theatre waiting area still has a low density. These findings indicate a significant research gap and open up opportunities to develop technology-based innovations to support family-centred perioperative care. Consequently, the development of digital applications to reduce family anxiety in operating theatre waiting rooms holds high potential for innovation and could become a relevant area of research in the future.

Table 1.
Mapping of Keyword Co-occurrence Analysis

Cluster	Color	Main Keywords	Research Theme	Interpretation
Cluster 1	Green	Operating room, patient, care, management, application, nurse, safety, anesthesiologist, operating room nurse	Perioperative and Operating Room Management	Focuses on operating room management, patient safety, nursing care, and the implementation of healthcare applications to improve perioperative services.
Cluster 2	Red	Mental health, psychological distress, depressive symptom, anxiety, association, prevalence, parent, father, health	Mental Health and Family Well-being	Highlights studies related to psychological distress, anxiety, depression, and the emotional impact of surgery on patients' families and caregivers.
Cluster 3	Blue	Randomized controlled trial, effectiveness, control group, trial, systematic review, review, group	Evidence-Based Interventions	Represents studies evaluating the effectiveness of interventions through experimental designs and systematic reviews.
Cluster 4	Yellow	Fear, perception, interview, qualitative study, attitude, knowledge, area	Perception and Qualitative Experience	Emphasizes qualitative research exploring perceptions, experiences, attitudes, and emotional responses of patients and families during the perioperative process.

Table 2.
Mapping of the Most Productive Authors

Rank	Author	Number of Publications	Description
1	Behzad Imani	13	Active contributor in perioperative nursing, family-centered care, and anxiety management interventions.
2	Franklin Dexter	11	Widely recognized for research on operating room management, surgical workflow, and healthcare systems optimization.
3	Mitchell H. Tsai	8	Focuses on anesthesiology, perioperative medicine, and quality improvement in surgical services.
4	Richard D. Urman	8	Conducts research in anesthesiology, perioperative patient safety, and digital healthcare innovation.
5	Armin Fereidouni	6	Contributes to studies on perioperative care and psychological support interventions.
6	Amirali Alizadeh	6	Research interests include healthcare management and perioperative patient outcomes.
7	Camellia Torabizadeh	6	Focuses on nursing care, family support, and mental health in clinical settings.
8	Richard H. Epstein	6	Specializes in operating room efficiency, patient safety, and anesthesia management.
9	P. N. Awasthi	5	Contributes to research related to perioperative practice and healthcare service delivery.
10	Esmacil Teymoori	5	Conducts studies on mental health, family well-being, and healthcare interventions.

Table 3.
Mapping of Countries with Contributions

Rank	Country	Number of Publications	Main Focus	Bibliometric Representation
1	United States	128	Operating room management, perioperative care, patient safety, and digital health innovation	High publication productivity and strong international collaboration network
2	United Kingdom	76	Family-centered care, perioperative communication, and anxiety management	High citation impact and multidisciplinary collaboration
3	China	68	Healthcare technology, mobile health applications, and surgical nursing	Rapidly growing research output
4	Australia	52	Psychological support, patient experience, and perioperative nursing	Strong collaboration with European and North American institutions
5	Canada	47	Family support interventions and digital healthcare services	Active contributor to evidence-based perioperative practice
6	Iran	41	Mental health, family anxiety, and nursing interventions	Emerging research hub in family-centered perioperative care
7	South Korea	35	Smart healthcare systems and digital nursing applications	Increasing contribution to healthcare technology research
8	India	31	Perioperative nursing, healthcare management, and patient-family support	Expanding research productivity in digital health
9	Germany	27	Surgical care quality improvement and healthcare innovation	Strong emphasis on clinical outcomes research
10	Netherlands	23	Patient-centered care and healthcare communication systems	Well-established international research collaborations

DISCUSSION

Research Structure Based on Network Visualization

The results of the network visualisation show that research on applications for reducing family anxiety in operating theatre waiting areas forms four main interconnected clusters, namely perioperative care and operating theatre management, family mental health, evaluation of evidence-based interventions, and the perceptions and experiences of patients and their families (Howe, 2021; Howe et al., 2021b). The perioperative care cluster is dominated by the keywords ‘operating room’, ‘patient’, ‘care’, and ‘management’, indicating that the majority of research remains focused on improving the quality of care and patient safety. On the other hand, the mental health cluster, comprising ‘mental health’, ‘psychological distress’, and ‘anxiety’, indicates a growing focus on psychological aspects within healthcare (Luengo et al., 2023; M. Xie et al., 2025). However, the relationship between the keyword ‘application’ and the family mental health cluster remains relatively weak. This finding suggests that the use of digital applications as an intervention to reduce family anxiety has not yet been extensively explored and presents an opportunity for further research (figure 2) & (table 1).

Research Trends Based on Overlay Visualization

An analysis of the visualisation overlay reveals a shift in the direction of research over time. Themes relating to the operating theatre, management and clinical application are long-standing topics that form the foundation of research in the perioperative field. As science has progressed, research has begun to shift towards mental health issues, marked by the emergence of keywords such as mental health, psychological distress, parent, and depressive symptoms as emerging topics. This shift reflects the growing attention to the emotional impact experienced by families during the surgical process. However, digital applications have not yet shown a strong correlation with the theme of family mental health, so there is still scope to develop technology-based innovations to support family-centred care (figure 3) & (table 1).

Research Density and Identification of Research Gaps

The results of the density visualisation show that research is concentrated on the keywords ‘operating room’, ‘patient’, ‘care’, ‘management’ and ‘mental health’, which are characterised by high density levels. This indicates that research on perioperative care and mental health has developed well and has become a major focus in the scientific literature. Conversely, themes related to digital applications for patients’ families have a lower density, indicating that this field remains under-researched. The low intensity of research in this area highlights a research gap between perioperative care, family mental health, and digital technology. Therefore, the development of digital applications to reduce anxiety among families in operating theatre waiting areas holds high potential for innovation and is relevant to the development of modern healthcare services (figure 4) & (table 1).

Intellectual Structure Based on Keyword Co-occurrence Analysis

An analysis of keyword co-occurrence identified four research clusters that form the intellectual framework of this field. The first cluster focuses on perioperative care and operating theatre management; the second on mental health and family well-being; the third on the effectiveness of evidence-based interventions; and the fourth on the perceptions and experiences of patients and their families (Howe et al., 2021b; Linjun et al., 2025b). The formation of these clusters indicates that research has developed in a multidisciplinary manner and involves various approaches, both quantitative and qualitative. However, the link between digital applications and family mental health has not yet formed a strong cluster. This suggests that research into applications designed to reduce family anxiety in operating theatre waiting areas still offers significant potential for development as a new field of research (table 1).

Contribution of Productive Authors

Analysis of the most productive authors reveals that several authors have made consistent contributions to research in the fields of perioperative care, mental health, and operating theatre management. The productivity of these authors reflects the existence of a group of researchers actively advancing knowledge in the fields of nursing, anaesthesiology, and healthcare. The majority of the research produced still focuses on improving service quality, patient safety, and the evaluation of various interventions to enhance the patient experience (Ballıkaya & Bilgin, 2026; Pandit et al., 2025). However, research specifically developing digital applications as a means of reducing family anxiety remains relatively limited. This situation indicates that the integration of digital technology and family-centred care remains an area of research that requires further development (table 2).

Global Research Contributions

An analysis of countries by contribution shows that the United States, the United Kingdom, China, Australia and Canada are the countries with the highest number of publications (table 3). These countries focus their research on operating theatre management, perioperative care, health communication and digital innovation in healthcare. Conversely, developing countries such as Iran and India contribute more to research on mental health, family support, and nursing interventions. These differences in research focus indicate that scientific development in this field is influenced by the needs of each country's healthcare system. Nevertheless, research on digital applications to reduce family anxiety in operating theatre waiting areas has not yet become a major global theme, thereby opening up opportunities for the development of international research collaborations.

Research Implications and Future Directions

Overall, the results of the bibliometric analysis indicate that research on perioperative care and mental health has developed well, but the integration of application technology and psychological support for families remains limited. The results of network visualisation, overlay visualisation, density visualisation, and keyword co-occurrence indicate that the relationship between the keywords 'application', 'mental health', and 'family' has not yet been firmly established. Furthermore, analysis of author productivity and country contributions also suggests that research remains dominated by aspects of service management and patient safety. These findings indicate a significant research gap and provide a scientific basis for developing digital applications as a medium for education, communication, and psychological support for patients' families (Thompson-Brazill et al., 2020). The development of such innovations is expected to support the implementation of family-centred perioperative care whilst also serving as a new direction for research in the fields of digital health and perioperative nursing (Howe et al., 2021b).

CONCLUSION

Bibliometric analysis indicates that research on applications designed to reduce family anxiety in operating theatre waiting rooms is dominated by the themes of perioperative care, mental health, and the effectiveness of interventions. The results of network, overlay, density visualisation, and keyword co-occurrence analyses suggest that the integration of digital applications and psychological support for families has not yet been optimally developed. Analysis of the most productive authors and contributing countries indicates that the research is supported by multidisciplinary collaboration and dominated by countries with strong research capacity. However, the use of digital applications as an intervention to reduce family anxiety remains relatively limited, thus constituting an important research gap to be addressed. The novelty of this study lies in the integration of the concepts of digital health, family-centred perioperative care, and family anxiety management through the development of digital applications. This approach has the potential to serve as an innovation to improve the quality of perioperative care whilst supporting the psychological well-being of patients' families.

REFERENCES

- Adugbire, B. A., Jordan, P. J., Young, C., & Iwu-Jaja, C. (2025). Strategies for implementation of patient and family-centered care in the perioperative context: A scoping review. *Health Sciences Review*, 14, 100220. <https://doi.org/https://doi.org/10.1016/j.hsr.2025.100220>
- Akortiakuma, M. J. K., Dzansi, D. G., & Aziato, P. L. (2022). Psychological well-being of patients recovering from abdominal surgery: A qualitative study. *Perioperative Care and Operating Room Management*, 26. <https://doi.org/10.1016/j.pcorm.2021.100228>
- Ballıkaya, Ç., & Bilgin, Z. (2026). Effect of virtual reality on labor pain, comfort, and satisfaction: A randomized controlled trial. *EXPLORE*, 22(4), 103425. <https://doi.org/https://doi.org/10.1016/j.explore.2026.103425>
- Barberi, P. M. (2015). Reducing the Surgical Patient ' s Family Member ' s Anxiety Using an Electronic Patient Tracking Board.
- Chen, H.-Y., Chen, P.-Y., Hwang, G.-J., & Wu, S.-H. (2026). Beyond surgical applications: A systematic review of educational robotics in health professional development. *Nurse Education in Practice*, 92, 104734. <https://doi.org/https://doi.org/10.1016/j.nepr.2026.104734>
- Chiu, P. L., Li, H., Yap, K. Y., Lam, K. C., Pom, M., Yip, P. R., & Wong, C. L. (2023). Virtual Reality – Based Intervention to Reduce Preoperative Anxiety in Adults Undergoing Elective Surgery A Randomized Clinical Trial. 6(10), 1–14. <https://doi.org/10.1001/jamanetworkopen.2023.40588>
- Dexter, F., & Epstein, R. H. (2001). Reducing family members' anxiety while waiting on the day of surgery: systematic review of studies and implications of HIPAA health information privacy rules. *Journal of Clinical Anesthesia*, 13(7), 478–481. [https://doi.org/https://doi.org/10.1016/S0952-8180\(01\)00322-1](https://doi.org/https://doi.org/10.1016/S0952-8180(01)00322-1)
- Elger, B. M., Esparaz, J. R., Nierstedt, R. T., Jennetten, R. C., Aprahamian, C. J., & Pearl, R. H. (2020). Engaging the patient and family in the surgical safety process utilizing. *Journal of Pediatric Surgery*, 55(4), 597–601. <https://doi.org/https://doi.org/10.1016/j.jpedsurg.2019.06.012>
- Enfermería, R., Rica, C., Esteves, I. M., Coelho, M. S., Cardoso, D., Prata, A. P., & Esteves, I. M. (2023). Effectiveness of perioperative family- centered educational interventions in the anxiety , pain and behaviors of children / adolescents and their parents : Systematic Review Protocol. 44.
- Griffiths, N., Laing, S., Spence, K., Foureur, M., Popat, H., Gittany, H., Sinclair, L., & KASPARIAN, N. (2024). Mental health screening for parents following surgical neonatal intensive care unit (NICU) discharge. *Early Human Development*, 198, 106128. <https://doi.org/https://doi.org/10.1016/j.earlhumdev.2024.106128>
- Howe, L. S. (2021). Research and Reviews Perioperative Family Updates Reduce Anxiety and Improve Satisfaction : A Randomized Controlled Trial Perioperative Family Updates Reduce Anxiety and Improve Satisfaction : A. 8(2). <https://doi.org/10.17294/2330-0698.1805>
- Howe, L. S., Wigmore, D., Nelms, N., Schottel, P., Bartlett, C., Halsey, D., Krag, M., Lunardini, D., Monsey, R., Beynnon, B., & Blankstein, M. (2021b). Perioperative Family Updates Reduce Anxiety and Improve Satisfaction: A Randomized Controlled Trial. *Journal of Patient-Centered Research and Reviews*, 8(2), 107–112. <https://doi.org/10.17294/2330-0698.1805>
- Kerimaa, H., Hakala, M., Haapea, M., Serlo, W., & Pölkki, T. (2024). The preparation of children for day surgery from the parent's viewpoint: A mixed methods study. *Nursing Open*, 11(3). <https://doi.org/10.1002/nop2.2121>
- Kuizon-Damasco, B. J., & Valledor-Pasamonte, R. C. (2026). Beyond the operating room: Advancing patient-centered care on the day of surgery. In *Perioperative Care and Operating Room Management* (Vol. 43, p. 100660). Elsevier BV. <https://doi.org/10.1016/j.pcorm.2026.100660>
- Kumar, M., Kumari, S., Guntipally, S. S., Chhabra, A., Kumar, A., & Kumar, P. (2024). A Step-By-Step Guide of Bibliometric Study for Healthcare and Allied Research. *Journal of Pharmacy & Bioallied Sciences*, 16(Suppl 4), S4114–S4116. https://doi.org/10.4103/jpbs.jpbs_1347_24

- Linjun, Y., Xi, L., Yanmei, Y., Wulajing, L., Linjie, F., Jingping, K., & Xiao, H. (2025a). Perioperative real-time information sharing and its impact on family members' anxiety in patients undergoing elective thoracoscopic lobectomy: a single-center randomized controlled trial. *Perioperative Medicine* (London, England), 14(1), 19. <https://doi.org/10.1186/s13741-025-00499-8>
- Linjun, Y., Xi, L., Yanmei, Y., Wulajing, L., Linjie, F., Jingping, K., & Xiao, H. (2025b). Perioperative real-time information sharing and its impact on family members' anxiety in patients undergoing elective thoracoscopic lobectomy: a single-center randomized controlled trial. *Perioperative Medicine*, 14(1). <https://doi.org/10.1186/s13741-025-00499-8>
- Luengo, T. D., Rivas, A. B., Loureido, E., & Vargas, E. (2023). Reducing preoperative anxiety in parents of surgical patients. *Heliyon*, 9(5), e15920. <https://doi.org/https://doi.org/10.1016/j.heliyon.2023.e15920>
- Marais, T. R., & Downing, C. (2022). The Experiences of the Operating Department Assistants in the Perioperative Environment. *International Journal of Africa Nursing Sciences*, 17, 100426. <https://doi.org/https://doi.org/10.1016/j.ijans.2022.100426>
- Marzi, G., Balzano, M., Caputo, A., & Pellegrini, M. M. (2025). Guidelines for Bibliometric-Systematic Literature Reviews: 10 steps to combine analysis, synthesis and theory development. *International Journal of Management Reviews*, 27(1), 81–103. <https://doi.org/https://doi.org/10.1111/ijmr.12381>
- Najout, H., Moutaouakil, M., Masad, I., Atmani, W., & Bensghir, M. (2026). Relatives' Needs, Anxiety, and Expectations During the Intraoperative Waiting Period: A Cross-Sectional Survey in a Tertiary Referral Hospital in Morocco. *Cureus*, 18(2), e104101. <https://doi.org/10.7759/cureus.104101>
- Pai, S., Bautista, R. O., Flen, A., Martin, L., & Burnett, G. W. (2026). The impact of language discordance between provider and patient on perioperative anesthetic care: A scoping review. *Patient Education and Counseling*, 147, 109540. <https://doi.org/https://doi.org/10.1016/j.pec.2026.109540>
- Pandit, D. D., Bhavana, S., Nileshwar, A., T, L., Ballala, K., Raj, E. A., Somu, S., & Kamath, R. (2025). Global Communication Practices and Their Impact on Patient Caregivers' Satisfaction in the Surgical Waiting Area: A Scoping Review. *Healthcare* (Switzerland), 13(12). <https://doi.org/10.3390/healthcare13121408>
- Passas, I. (2024). Bibliometric Analysis : The Main Steps. 1014–1025.
- Pourdell, B., Hosseini, S. A., & Rajabi, E. (2026). Clinical and structural outcomes of hybrid operating rooms in adult cardiac surgery: a systematic review. *Perioperative Care and Operating Room Management*, 42. <https://doi.org/10.1016/j.pcorm.2025.100607>
- Rarani, S. A. (2025). "One family, one patient": a human-centered approach to safety in the operating room. In *Patient Safety in Surgery* (Vol. 19, Issue 1). Springer Science and Business Media LLC. <https://doi.org/10.1186/s13037-025-00436-0>
- Salphale, Y. S., Saodekar, H., Kimmatkar, N., Shinde, G., Kothari, P., & Salphale, A. Y. (2026). Psychological outlook and recovery after orthopaedic trauma: Evidence and implications for Central India and other low-resource settings. In *Injury* (Vol. 57, Issue 8, p. 113389). <https://doi.org/10.1016/j.injury.2026.113389>
- Sawicki, C. M., Pielech, M., & Wade, S. D. (2024). Perioperative Information Needs of Parents of Patients With Special Health Care Needs: A Cross-Sectional Study. *Pediatric Dentistry*, 46(5), 324–331. <http://www.ncbi.nlm.nih.gov/pubmed/39420486>
- Suchodolska, G., & Senkus, E. (2022). Mobile applications for early breast cancer chemotherapy-related symptoms reporting and management: A scoping review. *Cancer Treatment Reviews*, 105, 102364. <https://doi.org/https://doi.org/10.1016/j.ctrv.2022.102364>
- Thompson-Brazill, K. A., Tierney, C. C., Brien, L., Wininger, J. W., & Williams, J. B. (2020). Enhancing Family-Centered Care in Cardiothoracic Surgery. *Critical Care Nursing Clinics of North America*, 32(2), 295–311. <https://doi.org/https://doi.org/10.1016/j.cnc.2020.02.010>

- Winterberg, A. V, Puntambekar, A. P., & Varughese, A. M. (2024). 31 - From idea to commercialization: development of a breathing-controlled gaming device for pediatric anesthesia induction. In A. Eltorai & P. B. T.-I. in A. Mathur (Eds.), *Clinical and Medical Innovation* (pp. 401–409). Academic Press. <https://doi.org/https://doi.org/10.1016/B978-0-12-818381-6.00015-2>
- Xie, M., Wu, B., Xu, Q., Lai, Q., & Cai, X. (2025). The application of targeted psychological care during perioperative period on children with facial trauma undergoing plastic surgery: A retrospective study. *Journal of Pediatric Nursing*, 82, e50–e56. <https://doi.org/https://doi.org/10.1016/j.pedn.2025.03.017>
- Xie, W., Ye, F., Yan, X., Cao, M., Ho, M.-H., Kwok, J. Y. Y., & Lee, J. J. (2023). Acupressure can reduce preoperative anxiety in adults with elective surgery: A systematic review and meta-analysis of randomised controlled trials. *International Journal of Nursing Studies*, 145. <https://doi.org/10.1016/j.ijnurstu.2023.104531>
- Yie, K., Shin, A.-R., Jeong, E.-H., Kim, B.-M., & Hwang, E.-J. (2025). Efficacy of family presence in the operating room during endovenous treatment: An EFFORT prospective observational study. *Journal of Vascular Surgery: Venous and Lymphatic Disorders*, 13(4), 102237. <https://doi.org/https://doi.org/10.1016/j.jvsv.2025.102237>