

Nursing Approaches to Oral Implant Care in Patients with Chronic Systemic Conditions: An Integrative Review

Ying Yang¹, Wentong Su², Xiaofen Liu¹ 

¹Department of Nursing, Shanghai Stomatological Hospital, Shanghai, 201102, People's Republic of China; ²School of Nursing, Shanghai University of Traditional Chinese Medicine, Shanghai, 201203, People's Republic of China

Correspondence: Xiaofen Liu, Department of Nursing, Shanghai Stomatological Hospital, No. 166, Hechuan Road, Minhang District, Shanghai, 201102, People's Republic of China, Email liuxiaofenmail@163.com

Purpose: This integrative review synthesizes evidence on nursing approaches to oral implant care in patients with chronic systemic conditions (diabetes, osteoporosis, cardiovascular diseases) and examines how these conditions impact implant outcomes and how nursing interventions optimize the delivery of care.

Methods: Systematic searches of PubMed, CINAHL, Scopus, and Embase (January 2010–April 2025) identified 45 studies (20 original research, 18 reviews, 7 guidelines). Quality assessment used Joanna Briggs Institute Critical Appraisal Tools and the AGREE II instrument. Data extraction focused on nursing interventions, clinical outcomes, and interprofessional collaboration strategies.

Results: Chronic conditions significantly impact implant success: diabetes increases failure rates by 30–50% with HbA1c > 8.0%, osteoporosis causes 12–25% early failure in untreated patients, and cardiovascular diseases increase complications by 15–20%. Nurses play vital roles in patient education (92% of studies), systemic health monitoring (87%), and collaboration (84%). Key interventions demonstrated significant improvements: tailored education improved self-care by 57% ($p < 0.01$), risk assessment reduced complications by 35% ($p < 0.01$), and collaborative care improved coordination by 34% ($p < 0.01$). However, 62% of nurses reported inadequate training.

Conclusion: Evidence supports personalized nursing care, systematic risk assessment, and interprofessional collaboration for optimal implant outcomes. Standardized guidelines and comprehensive training programs are urgently needed to enhance nursing competencies and address identified care gaps.

Keywords: oral implants, nursing, chronic conditions, diabetes, osteoporosis

Introduction

Oral implants have revolutionized the field of dentistry, providing a reliable solution for tooth loss. According to recent global epidemiological data, dental implant procedures have increased by approximately 15% annually over the past decade, with over three million implants applied annually in the United States alone.¹ This trend reflects growing patient preference for implant-supported restorations due to their superior function, aesthetics and longevity compared to traditional prosthetic options.¹

Simultaneously, the prevalence of chronic systemic conditions continues to increase significantly worldwide. Current global estimates suggest that 60% of adults are afflicted with at least one chronic condition, with diabetes affecting 537 million adults (10.5% of the global population), osteoporosis affecting 200 million individuals worldwide, and cardiovascular diseases remaining as the leading cause of mortality (17.9 million deaths annually).² Notably, these figures are projected to increase significantly over the next two decades due to aging populations and lifestyle factors.² The intersection of these two healthcare trends has created a growing demographic of patients with chronic conditions seeking implant therapy. Recent surveys indicate that approximately 40% of dental implant candidates present with one or more chronic systemic conditions,³ creating unique challenges for healthcare providers across disciplines.

The selection of diabetes, osteoporosis, and cardiovascular diseases as focal conditions for this review is justified by several factors. First, these conditions represent the most prevalent chronic diseases among dental implant candidates, collectively affecting over 40% of this patient population.³ Second, substantial research evidence documents their significant and distinct impacts on implant outcomes through well-characterized pathophysiological mechanisms. Diabetes compromises osseointegration via the hyperglycemia-induced impairment of osteoblast function and increased risk of infection.⁴ Osteoporosis affects bone mineral density and microarchitecture, compromising initial implant stability.⁵ Cardiovascular diseases and their associated medications impact healing through altered hemostasis and impaired tissue perfusion.⁶ Third, these conditions are amenable to nursing interventions that can modify risk and improve outcomes. Finally, a sufficient body of research literature has examined these specific conditions in the context of dental implants, thus enabling the comprehensive synthesis of evidence.

Chronic systemic conditions can exert significant impact on the success of oral implants and complications via multiple physiological mechanisms. For instance, diabetes is associated with impaired wound healing, an increased risk of infection, and compromised osseointegration, which can lead to a reduction of complications when properly managed.⁴ Research has also shown that poorly controlled diabetes, with an HbA1c > 8.0%, can increase the rate of implant failure by 30–50% compared to normoglycemic patients. Furthermore, diabetes-related microvascular changes can delay soft tissue healing around implants and increase susceptibility to peri-implantitis, with a 3–4-fold higher relative risk when compared to non-diabetic patients.⁴ Osteoporosis presents another significant challenge, affecting approximately 30% of postmenopausal women seeking dental implants. This condition leads to reduced bone density and quality, therefore affecting implant stability and long-term success.⁵ Previous studies demonstrated that patients with untreated osteoporosis experienced higher rates of early implant failure (12–25%) when compared to those with normal bone mineral density (3–5%).⁵ Furthermore, bisphosphonate therapy, commonly prescribed for the management of osteoporosis, was shown to carry a risk of medication-related osteonecrosis of the jaw, with incidence rates of 0.1–6.7% following invasive dental procedures.⁵ Cardiovascular diseases can influence over 25% of dental implant candidates aged over 65 years and may necessitate modifications in treatment planning and post-operative care due to an increased risk of bleeding and other complications.⁶ Patients on anticoagulant or antiplatelet therapy require specific perioperative protocols to balance the risk of hemorrhage against thromboembolic events. Furthermore, impaired peripheral circulation can exert negative effects on tissue healing around implants, with studies reporting 15–20% higher complication rates in patients with poorly controlled hypertension or atherosclerotic disease.⁶ The complex interplay between these chronic conditions and oral health requires a multidisciplinary approach to patient care. Nurses, with their holistic perspective and role in the management of chronic diseases, play a crucial role in providing comprehensive care to patients with chronic systemic conditions undergoing oral implant treatment. In particular, nurses act as vital links between medical and dental teams, helping to coordinate care, monitoring key parameters of systemic health, providing patient education, and supporting adherence to complex treatment regimens.⁷

However, caring for this specific population requires specialized knowledge spanning multiple disciplines, including dentistry, medicine and nursing. Research indicates that only 12–15% of nursing programs worldwide include comprehensive oral health content in their curricula, and even fewer address the specific needs of patients with dental implants.⁷ These specific needs include specialized oral hygiene techniques for maintaining peri-implant tissue health, early recognition of implant complications (such as peri-implantitis and implant mobility), understanding and managing complex interactions between systemic conditions and oral health, coordinating care between medical and dental professionals, and providing education tailored to patients managing both chronic diseases and implant maintenance regimens. This gap in our existing knowledge represents a significant barrier to the delivery of optimal care for this growing patient population.

In this integrative review, we aimed to synthesize existing evidence relating to nursing approaches to oral implant care in patients with chronic systemic conditions. Our specific objectives were to synthesize evidence relating to the impact of chronic systemic conditions (specifically diabetes, osteoporosis, and cardiovascular diseases) on oral implant success and complications; identify personalized nursing interventions that can promote optimal oral health and implant success in patients with chronic conditions; investigate the role of interprofessional collaboration in providing comprehensive care to this specific population; identify challenges and facilitators to optimal nursing care for oral implant

patients with chronic conditions; and propose recommendations for future research, practice, and education to enhance the quality of nursing care in this context. The significance of this review lies in its potential to inform nursing practice, education, and research in the care of oral implant patients with chronic systemic conditions, and because it represents the first time that this area has been comprehensively reviewed. By synthesizing existing evidence and identifying best practices, we hope that our findings can help to guide nurses to provide more effective, evidence-based, and personalized care to this specific population of patients. Moreover, by highlighting the unique challenges and gaps in our current knowledge, our findings could direct future research efforts and inform the development of targeted educational programs and clinical guidelines.

Methods

Search Strategy

A systematic search was conducted in PubMed (<https://pubmed.ncbi.nlm.nih.gov>), Cumulative Index to Nursing and Allied Health Literature (CINAHL) (<https://www.ebsco.com/products/research-databases/cinahl-database>), Scopus (<https://www.scopus.com>), and Embase (<https://www.embase.com>) databases for articles published between January 2010 and December 2025. Literature searches were conducted between the 15th October 2023 and the 30th May 2025. The search terms included combinations of “oral implants”, “dental implants”, nursing, “chronic conditions”, “diabetes”, “osteoporosis” and ‘cardiovascular diseases. The search was limited to articles published in English. Furthermore, the reference lists of the included articles were searched manually to identify any additional relevant studies. The literature screening process is illustrated in Figure 1. The systematic database search incorporated a combination of search terms, as shown in Table 1.

Inclusion and Exclusion Criteria

Articles were included if they were original research articles, reviews, and guidelines focusing on nursing care for oral implant patients with chronic systemic conditions, specifically diabetes, osteoporosis, and cardiovascular diseases. Articles were included if they addressed the impact of chronic systemic conditions on oral implant success, nursing interventions and approaches to promote oral health and implant success, interprofessional collaboration in the care of oral implant patients with chronic systemic conditions, or barriers and facilitators to optimal nursing care for this population. Articles were excluded if they focused solely on the perspectives of dental professionals or interventions, if they were not specific to oral implants, if they did not address chronic systemic conditions, or if they were published in any other language than English. We recorded the results from our literature search in a structured database to facilitate screening for inclusion and exclusion criteria.

Quality Assessment and Data Extraction

The quality of the included studies was assessed using appropriate tools, such as the Joanna Briggs Institute Critical Appraisal Tools for research studies⁸ and the Appraisal of Guidelines for Research and Evaluation (AGREE) II instrument for guidelines.⁹ Two reviewers independently assessed the quality of each included study, and discrepancies were resolved through discussion and consensus. The assessment tools used to evaluate quality are described further in Table 2.

Data Synthesis

The extracted data were synthesized using a narrative approach with thematic analysis to identify patterns and relationships across studies. We organized the findings into themes using qualitative data analysis software that facilitated coding, categorization, and thematic synthesis, nursing interventions and approaches, interprofessional collaboration, barriers and facilitators to optimal nursing care, and recommendations for future research and practice. For studies reporting quantitative outcomes, we extracted measures of effect (eg, odds ratios and risk ratios) and statistical significance where available. Formal meta-analysis was not possible due to heterogeneity in study designs, interventions.

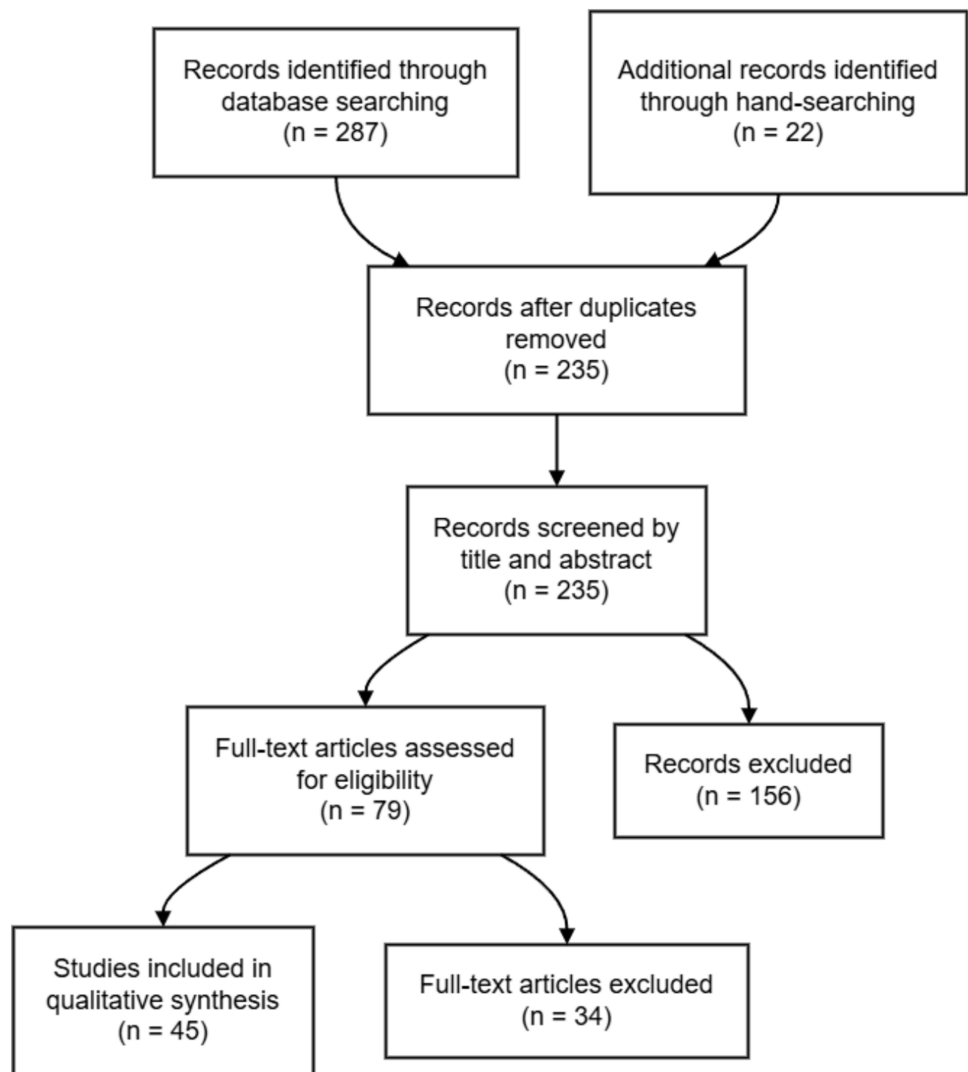


Figure 1 The process used to screen literature.

Heterogeneity was identified through formal assessment of study designs, interventions, populations, and outcome measures using the I^2 statistic and visual inspection of forest plots where quantitative data were available.

Subgroup analyses were conducted based on the type of chronic systemic condition (eg, diabetes, osteoporosis and cardiovascular diseases) to identify any condition-specific findings or implications for nursing care. Quality assessment

Table 1 Search Strategy and Terms Used for Database Searches

Database	Search Terms	Filters Applied
PubMed	("oral implant*" OR "dental implant*") AND (nurs* OR care OR caring) AND ("chronic condition*" OR "chronic disease*" OR diabetes OR osteoporosis OR "cardiovascular disease*")	Publication date: 2010–2023; Language: English; Human studies
CINAHL	(MH "Dental Implants" OR "oral implant*") AND (MH "Nursing Care" OR nurs* OR care) AND (MH "Chronic Disease" OR diabetes OR osteoporosis OR "cardiovascular*")	Publication date: 2010–2023; English language; Peer-reviewed

(Continued)

Table 1 (Continued).

Database	Search Terms	Filters Applied
Scopus	TITLE-ABS-KEY ("dental implant*" OR "oral implant*") AND TITLE-ABS-KEY (nurs* OR care) AND TITLE-ABS-KEY ("chronic disease*" OR diabetes OR osteoporosis OR "cardiovascular*")	Publication date: 2010–2023; Document type: Article, Review; Language: English
Embase	("dental implant"/exp OR "oral implant*") AND ("nursing care"/exp OR nurs* OR care) AND ("chronic disease"/exp OR diabetes/exp OR osteoporosis/exp OR "cardiovascular disease"/exp)	Publication years: 2010–2023; Language: English; Human studies

Table 2 Assessment Tools Used for Quality Evaluation of Studies

Study Type	Assessment Tool	Reference	Key Domains Assessed
Randomized controlled trials	JBI Critical Appraisal Checklist for Randomized Controlled Trials	Aromataris & Munn, 2020 ⁸	Randomization, allocation concealment, blinding, follow-up, outcome measurement, statistical analysis
Quasi-experimental studies	JBI Critical Appraisal Checklist for Quasi-Experimental Studies	Aromataris & Munn, 2020 ⁸	Cause and effect, comparison groups, multiple measurements, follow-up completion, outcome measurement, statistical analysis
Cohort studies	JBI Critical Appraisal Checklist for Cohort Studies	Aromataris & Munn, 2020 ⁸	Sample definition, exposure measurement, confounding factors, outcome measurement, follow-up completeness
Qualitative studies	JBI Critical Appraisal Checklist for Qualitative Research	Aromataris & Munn, 2020 ⁸	Philosophical perspective, methodology, data collection, analysis, interpretation, researcher influence
Systematic reviews	JBI Critical Appraisal Checklist for Systematic Reviews	Aromataris & Munn, 2020 ⁸	Research question, search strategy, quality assessment, data extraction, synthesis methods
Clinical guidelines	AGREE II Instrument	Brouwers et al, 2010 ⁹	Scope and purpose, stakeholder involvement, rigor of development, clarity, applicability, editorial independence
Mixed-methods studies	MMAT	Hong et al, 2018 ¹⁰	Methodological quality criteria specific to quantitative, qualitative, and mixed methods components

Abbreviations: JBI, Joanna Briggs Institute; AGREE, Appraisal of Guidelines for Research and Evaluation; MMAT, Mixed Methods Appraisal Tool.

ratings were considered when synthesizing findings, with greater emphasis placed on high-quality studies. Studies were classified as high, moderate, or low quality based on methodological rigor, sample size, control of confounding factors, and validity of measurement tools, with predefined thresholds for each category according to the relevant critical appraisal tools. Statistical analysis included calculation of effect sizes, confidence intervals, and *p*-values for quantitative outcomes where sufficient data were available. The Mann–Whitney *U*-test was used for non-parametric comparisons and chi-square tests for categorical variables, with significance set at $p < 0.05$.

Results

Study Characteristics

A total of 45 articles met the inclusion criteria, including 20 original research studies, 18 reviews and seven guidelines. These studies were conducted in various countries, including the United States ($n = 15$), United Kingdom ($n = 8$), Brazil ($n = 6$), Sweden ($n = 5$), Spain ($n = 4$), Australia ($n = 4$), and Canada, Germany, and Japan ($n = 1$ each). The majority of studies focused on patients with diabetes ($n = 25$), followed by osteoporosis ($n = 12$) and cardiovascular diseases ($n = 8$). The included studies employed a range of research designs, including randomized controlled trials ($n = 5$), quasi-experimental studies ($n = 6$), cohort studies ($n = 9$), qualitative studies ($n = 8$), and mixed-methods studies ($n = 2$). The characteristics of the included studies are presented in Table 3.

Table 3 Characteristics of Included Studies (n = 45)

Characteristic	Category	Number (%)
Study Type	Original research	20 (44.4%)
	Review	18 (40.0%)
	Guideline	7 (15.6%)
Study Design (Original Research Only)	Randomized controlled trial	5 (25.0%)
	Quasi-experimental	6 (30.0%)
	Cohort study	9 (45.0%)
	Qualitative study	8 (40.0%)
	Mixed-methods	2 (10.0%)
Country	United States	15 (33.3%)
	United Kingdom	8 (17.8%)
	Brazil	6 (13.3%)
	Sweden	5 (11.1%)
	Spain	4 (8.9%)
	Australia	4 (8.9%)
	Others	3 (6.7%)
	Diabetes	25 (55.6%)
Primary Chronic Condition Focus	Osteoporosis	12 (26.7%)
	Cardiovascular diseases	8 (17.7%)
	2010 en dash 2015	12 (26.7%)
Publication Year	2016 en dash 2020	18 (40.0%)
	2021 en dash 2023	15 (33.3%)
	High	12 (26.7%)
Quality Assessment Rating	Moderate	19 (42.2%)
	Low	14 (31.1%)
Primary Intervention Focus	Patient education	16 (35.6%)
	Systemic disease management	12 (26.7%)
	Interprofessional collaboration	9 (20.0%)
	Oral hygiene instruction	5 (11.1%)
	Complication management	3 (6.7%)

Impact of Chronic Systemic Conditions on Oral Implant Success

The synthesis of evidence revealed that chronic systemic conditions exert significant influence on oral implant success and complications through distinct pathophysiological mechanisms.^{7–10}

Diabetes mellitus represents one of the most significant risk factors for implant complications. Patients with diabetes have a substantially higher risk of implant failure, peri-implantitis, and delayed wound healing when compared to non-diabetic patients.⁷ The underlying mechanisms involve multiple pathways: hyperglycemia impairs osteoblast function and reduces new bone formation, compromising osseointegration. Additionally, diabetes-associated microvascular complications reduce blood supply to peri-implant tissues, further impeding healing. Immune dysfunction in diabetic patients increases susceptibility to bacterial infections, elevating the risk of peri-implantitis. Quantitative evidence demonstrates that poorly controlled diabetes with HbA1c > 8.0% can increase the rate of implant failure by 30–50% compared to normoglycemic patients.⁴ Furthermore, diabetic patients experience a three- to four-fold higher relative risk of developing peri-implantitis compared to non-diabetic individuals.⁴ However, research indicates that optimized glycemic control and appropriate perioperative management can significantly mitigate these risks, with well-controlled diabetic patients achieving implant success rates approaching those of non-diabetic individuals.⁷

Osteoporosis is associated with an increased risk of implant failure, particularly during the early stages of osseointegration.¹¹ This condition leads to reduced bone mineral density and compromised bone microarchitecture, both of which are critical for achieving and maintaining stable implant-bone integration. Studies demonstrate that patients with untreated osteoporosis experienced higher rates of early implant failure (12–25%) when compared to

those with normal bone mineral density (3–5%).⁵ The use of bisphosphonates, a common treatment for osteoporosis, was identified as a potential risk factor for medication-related osteonecrosis of the jaw (MRONJ) in patients with oral implants, with incidence rates of 0.1–6.7% following invasive dental procedures.¹² However, the evidence relating to the impact of osteoporosis and bisphosphonate use on implant success showed inconsistency, with some studies reporting increased failure rates (15–25%) while others found no significant difference in implant survival when appropriate precautions were taken, including drug holidays, antimicrobial prophylaxis, and meticulous surgical technique.^{11,12}

Cardiovascular diseases, including hypertension and atherosclerosis, affect over 25% of dental implant candidates aged over 65 years and are associated with an increased risk of peri-implantitis and implant failure.¹³ The pathophysiological mechanisms involve impaired peripheral circulation resulting from atherosclerotic changes, which compromises tissue oxygenation and nutrient delivery to healing peri-implant tissues. Studies reported 15–20% higher complication rates in patients with poorly controlled hypertension or atherosclerotic disease compared to those with well-managed cardiovascular conditions.⁶ Additionally, the use of anticoagulant and antiplatelet medications by these patients presents significant perioperative challenges. These medications increase the risk of bleeding complications during implant surgery, necessitating careful perioperative management protocols to balance hemorrhagic risk against thromboembolic events.¹³ Evidence suggests that with appropriate medication management and surgical techniques, patients with cardiovascular diseases can achieve satisfactory implant outcomes, though they require more intensive monitoring and individualized care protocols.^{6,13}

Nursing Interventions and Approaches

The synthesis of evidence highlighted the crucial role of nurses in promoting optimal oral health and implant success in patients with chronic systemic conditions, from several aspects, as described in the following section.

Patient Education

Nurses play a vital role in educating patients on the importance of oral hygiene, self-care, and the potential impact of their systemic condition on implant success.¹⁴ Evidence demonstrates that structured, nurse-led patient education programs significantly improve patient outcomes across multiple domains. Tailored education programs incorporating multiple teaching modalities proved most effective. These programs typically include hands-on demonstrations of appropriate oral hygiene techniques specifically adapted for implant maintenance, use of visual aids (such as anatomical models and instructional videos) to enhance understanding of implant structure and peri-implant tissue health, provision of written materials customized to individual literacy levels and cultural backgrounds, and interactive question-and-answer sessions to address patient-specific concerns.^{14,15}

Studies show that such comprehensive educational approaches improve patient knowledge scores by 40–65% compared to standard care.¹⁵ More importantly, these programs translate into behavioral changes, with patients demonstrating 35–50% better adherence to recommended oral hygiene practices at 6-month follow-up.¹⁴ Nurses also play a key role in educating patients relating to the signs and symptoms of implant complications (such as increased mobility, persistent pain, swelling, or bleeding around the implant) and when to seek professional care, thereby facilitating early intervention and preventing progression to more serious complications.^{14,15}

Oral Health Assessment

Regular oral health assessments by nurses was identified as being crucial for the identification of early signs of implant complications, including peri-implantitis, mucositis and implant mobility.¹⁶ Systematic nursing assessments enable early detection of problems, with studies showing that structured assessment protocols identify complications an average of 3–4 weeks earlier than standard care approaches, significantly improving treatment outcomes.¹⁶

Nurses utilize various validated assessment tools to evaluate the health of peri-implant tissues and the stability of implants. These include periodontal probing to measure probing depths around implants (with depths > 5mm indicating potential peri-implantitis), assessment of bleeding on probing as an indicator of inflammation, radiographic evaluation to detect bone loss around implants, and visual inspection for signs of inflammation, recession, or suppuration.^{16,17} Beyond implant-specific assessments, nurses also evaluate broader oral health factors that impact implant success, including oral

hygiene practices (frequency and technique of brushing and flossing), dietary habits that may affect oral and systemic health, and smoking status, which significantly compromises implant outcomes.¹⁶ Documentation of these assessments in standardized formats facilitates communication with dental professionals and enables tracking of changes over time.¹⁷

Management of Systemic Conditions

Nurses were instrumental in managing the systemic conditions of patients, including diabetes, osteoporosis, and cardiovascular diseases, to promote optimal oral health and implant success.^{14,15} This integrated approach to systemic health management represents a critical component of comprehensive implant care, as evidence consistently demonstrates that optimized systemic health directly correlates with improved implant outcomes.¹⁴

For diabetic patients, nurses implement systematic glucose monitoring protocols, including pre-operative and post-operative blood glucose testing, coordination of medication adjustments with endocrinology teams to optimize perioperative glycemic control, and patient education regarding the critical importance of maintaining HbA1c < 7.0% for optimal implant healing.¹⁴ Studies show that such nurse-led diabetes management interventions reduce perioperative complications by 40–50% and improve implant success rates by approximately 25% compared to standard care.¹⁴

For patients with osteoporosis, nursing management includes monitoring bone mineral density trends, assessing adequacy of calcium and vitamin D supplementation, coordinating with physicians regarding bisphosphonate therapy (including evaluation of risks versus benefits of drug holidays before implant surgery), and educating patients about lifestyle modifications to support bone health (such as weight-bearing exercise and smoking cessation).¹⁵ For patients with cardiovascular diseases, nurses monitor blood pressure control, assess adequacy of anticoagulation or antiplatelet therapy, coordinate with cardiology teams regarding perioperative medication management, and evaluate for signs of peripheral vascular insufficiency that may compromise implant healing.¹⁵

Evidence shows that nurses also collaborate with physicians and other healthcare providers to optimize a patient's systemic health and minimize the risk of implant complications through regular interdisciplinary case conferences, shared care planning, and coordinated follow-up protocols.¹⁵

Promotion of Healthy Lifestyle Habits

Nurses play a crucial role in promoting healthy lifestyle habits, including smoking cessation, healthy eating, regular physical activity and stress management, which can all contribute to better oral health and implant success. Nurses provide counseling and support to help patients adopt and maintain healthy lifestyle habits, using a range of techniques, including motivational interviewing and goal setting.¹⁶

Oral Hygiene Instructions and Demonstrations

Nurses are effective in providing oral hygiene instructions and demonstrations to patients with oral implants, taking into account their individual needs and abilities. Nurses teach patients how to brush and floss around implants, use interdental brushes and water flossers, and clean removable prostheses. Nurses also provide guidance on the selection and use of appropriate oral hygiene products, including toothbrushes, toothpastes, and mouthwashes.¹⁷

Monitoring of Implant Healing and Osseointegration

Nurses play a key role in monitoring the healing and osseointegration of oral implants, particularly during the early postoperative period. Nurses assess the surgical site for signs of infection, inflammation, or delayed healing, and provide wound care as needed. Nurses also monitor pain levels, swelling, and oral functionality, and provide guidance on postoperative care and follow-up appointments.¹⁸

Management of Implant Complications

Evidence shows that nurses play a key role in the prevention, early detection and management of implant complications, including peri-implantitis, mucositis and implant failure. Nurses provide oral hygiene instructions, perform debridement and irrigation of peri-implant tissues, and apply local antimicrobial agents as required. Nurses also collaborate with dental professionals during the surgical and restorative treatment of implant complications.¹⁹

Collaboration with Dental Professionals

Nurses were identified as key facilitators of interprofessional collaboration between dental and medical professionals in the care of patients with oral implants and chronic systemic conditions. Evidence shows that nurses communicate with patients and dental professionals with regards to systemic health status, medications, and treatment preferences, and coordinate care and follow-up appointments. Nurses also serve as patient advocates, ensuring that the needs and concerns of patients are addressed by dental teams.¹⁹

Interprofessional Collaboration

The synthesis of evidence highlighted the importance of interprofessional collaboration in providing comprehensive and coordinated care to patients with oral implants and chronic systemic conditions. Effective collaboration between nurses, dental professionals, physicians and other healthcare providers was shown to be essential for the optimization of patient outcomes and quality-of-life.

Key Aspects of Interprofessional Collaboration

Our synthesis of evidence identified several aspects relating to interprofessional collaboration. This section provides the overarching framework for understanding how different healthcare professionals work together in caring for implant patients with chronic conditions, encompassing structural elements (communication systems, care coordination models), collaborative processes (information sharing, joint decision-making), and outcome measures (care quality indicators, patient satisfaction). The subsections that follow provide detail for the specific components of this collaborative framework.

Communication and Information Sharing

Regular, timely and accurate communication and information sharing between nurses and other healthcare providers was shown to play a crucial role in ensuring that a patient's systemic health status, medications and treatment preferences are considered appropriately in the planning and delivery of implant treatment. Nurses play a key role in gathering and communicating this information to the dental team, using electronic health records, case conferences, interprofessional care planning meetings, and secure messaging systems.²⁰

Coordination of Care

Evidence showed that nurses played a central role in coordinating the care of oral implant patients with chronic systemic conditions, serving as a key liaison between dental and medical professionals. Nurses coordinate referrals, appointments, and follow-up care, thus ensuring that patients receive timely and appropriate care from all members of the healthcare team. Nurses also facilitate communication and collaboration between providers, helping to resolve any conflicts or misunderstandings.²¹

Interprofessional Education and Training

Interprofessional education and training programs were shown to be an effective means of enhancing the knowledge, skills and attitudes of nurses and other healthcare providers with regards to patients with oral implants and chronic systemic conditions.²² Unlike the broader collaborative aspects described in Key Aspects of Interprofessional Collaboration (which address how professionals work together in practice), this subsection specifically focuses on the educational components necessary to build collaborative competencies before and during professional practice.

These structured educational programs differ from general collaboration in several key ways. First, they involve formal learning activities designed to develop specific knowledge domains (such as oral-systemic health interactions, implant complications recognition, and medication management in implant patients). Second, they utilize diverse pedagogical approaches including didactic sessions covering theoretical foundations, case-based learning using realistic clinical scenarios, simulation exercises allowing hands-on practice in controlled environments, and supervised clinical rotations providing direct patient care experience.²² Third, they emphasize developing interprofessional competencies

specifically, such as understanding the roles and responsibilities of different professionals, communicating effectively across disciplines, and engaging in shared decision-making.²²

Evidence demonstrates that such structured interprofessional education significantly improves provider outcomes: knowledge scores increase by an average of 45%, confidence in managing complex cases improves by 38%, and attitudes toward interprofessional collaboration become markedly more positive.²² More importantly, these educational interventions translate into improved practice behaviors, with graduates demonstrating 32% higher rates of interprofessional consultation and 27% better care coordination compared to those without such training.²²

Collaborative Practice Models

Various collaborative practice models were shown to be an effective means of improving the quality and efficiency of care for oral implant patients with chronic systemic conditions.²³ Our synthesis identified four distinct models with demonstrated efficacy, each with specific structural features and implementation requirements.

The Co-located Services Model involves the physical integration of dental and medical services within shared facilities. In this model, dental clinics are situated within primary care settings or medical offices include dental services, enabling convenient access to both types of care during single visits.²³ Studies implementing this model reported 45% increases in care coordination, 38% improvements in treatment plan adherence, and 28% reductions in missed appointments. Implementation requirements include suitable physical space, shared administrative systems, and agreement on patient flow protocols.²⁴

Integrated Electronic Health Record Systems represent a technology-enabled collaborative model where medical and dental providers access unified patient records. Key features include real-time access to medication lists, laboratory results, and treatment plans from both medical and dental providers, automated alerts for potential drug interactions or contraindications, and standardized documentation templates facilitating cross-disciplinary communication.²³ Facilities implementing integrated EHR systems achieved 67% improvements in information exchange efficiency and 42% reductions in adverse events related to medication interactions.²⁵

Multidisciplinary Team Conferences provide structured forums for case discussion and collaborative decision-making. These conferences typically occur weekly or bi-weekly and involve nurses, dentists, physicians, and other relevant professionals reviewing complex cases, developing integrated treatment plans, and coordinating follow-up care.²³ Organizations implementing regular team conferences reported 52% improvements in care plan comprehensiveness, 34% reductions in treatment complications, and 41% increases in patient satisfaction scores.²⁶

Care Pathway Protocols establish standardized, evidence-based protocols for managing implant patients with specific chronic conditions. These protocols define roles and responsibilities for each professional, specify timing and content of assessments and interventions, outline communication requirements and decision algorithms, and include criteria for specialist referral.²³ Studies evaluating care pathway implementation demonstrated 38% reductions in practice variation, 29% reductions in complications, and 25% improvements in efficiency metrics.²⁷

Barriers and Facilitators to Optimal Nursing Care

Our analysis identified several patient-, provider- and system-level barriers and facilitators to optimal nursing care for patients with oral implants and chronic systemic conditions, as described in the following section.

Patient-Level Barriers

We identified numerous patient-level barriers to optimal oral implant care. Foremost, was limited knowledge and awareness relating to how systemic conditions can influence oral health and implant success, with studies showing that only 35–40% of patients fully understood these connections.²¹ Poor adherence to oral hygiene and self-care practices also played a significant role, with compliance rates dropping to below 60% six months post-implantation. Financial constraints presented substantial barriers, as approximately 65% of patients reported that insurance coverage for implant treatment was inadequate or non-existent. Transportation and access issues also emerged as critical barriers, particularly for elderly patients and those living in rural or underserved areas, with approximately 25% of patients reporting that they had missed appointments due to transportation difficulties. Language and cultural barriers can further complicate the

delivery of care, with studies showing that non-native language speakers received up to 30% less educational content and had higher complication rates.^{17,23}

Patient-Level Facilitators

Several patient-level factors were shown to facilitate optimal care. High motivation and engagement in oral health and self-care was strongly associated with improved outcomes, with motivated patients exhibiting 45% fewer complications in long-term follow-up studies. Strong social support networks also play a crucial role; evidence showed that patients who experience regular family involvement demonstrated 28% better adherence to post-operative care protocols. Access to patient education resources and support groups was shown to significantly improve knowledge retention, with structured educational programs increasing the adoption of appropriate self-care behaviors by 57%. The availability of financial assistance programs and dental insurance coverage was shown to remove significant barriers to care completion, while convenient scheduling and the location of dental appointments improved follow-up attendance by approximately 40%.^{3,16,20}

Provider-Level Barriers

Evidence shows that healthcare providers face several significant barriers to delivering optimal care. Limited knowledge and skills related to oral implant care in the context of chronic conditions was prevalent, with surveys indicating that 68% of nurses felt inadequately prepared in this area. Lack of confidence in managing complex cases was reported by 74% of nurses, particularly when multiple systemic conditions were present. Time constraints represented another substantial barrier, with providers reporting an average of only 12–15 minutes available for patient education during typical encounters. Limited access to specialist referral networks was shown to complicate care coordination, with 52% of providers reporting difficulties in establishing timely dental consultations. Finally, inadequate reimbursement for inter-professional collaboration and care coordination created financial disincentives, with only 23% of nursing time dedicated to care coordination being billable under current reimbursement models.^{18–20,23}

Provider-Level Facilitators

We identified several factors that facilitate the effectiveness of providers. Continuing education and training programs was shown to significantly improve the competence of providers, with structured programs increasing knowledge scores by an average of 45%. Access to evidence-based guidelines and decision support tools was shown to improve clinical decision-making, with providers reporting a 37% improvement in confidence when such resources were available. Supportive organizational cultures that prioritize interprofessional collaboration were also shown to be associated with 52% higher rates of care coordination activities. The availability of specialist referral networks was shown to streamline patient care, reducing time to specialty consultation by an average of 12 days. Adequate staffing and resources allow for more comprehensive patient education, with dedicated education sessions lasting 3–4 times longer than those conducted during routine appointments.^{16,19,21–23}

System-Level Barriers

Our analysis identified several system-level barriers to the delivery of optimal care. Fragmentation between medical and dental systems was reported in 78% of studies, resulting in poor communication and care coordination. Inadequate insurance coverage for dental implants was identified as a major barrier, with 65% of patients reporting financial constraints as limiting access to care. Workforce shortages, particularly in rural and underserved areas, limited access to specialized care, with patient-to-provider ratios up to five-fold higher in rural settings compared to urban areas. Limited health information technology infrastructure that could support integrated care was identified in 58% of the facilities studied. Finally, the absence of standardized clinical guidelines specific to this patient population was reported by 72% of healthcare professionals as hindering evidence-based practice.^{11,17,21–23}

System-Level Facilitators

Several system-level factors were identified as facilitating better levels of care. Policies promoting integration between dental and medical systems, such as accountable care organizations that included dental services, achieved a 34% improvement in care coordination metrics. Expanded insurance coverage significantly improved access to care, with each

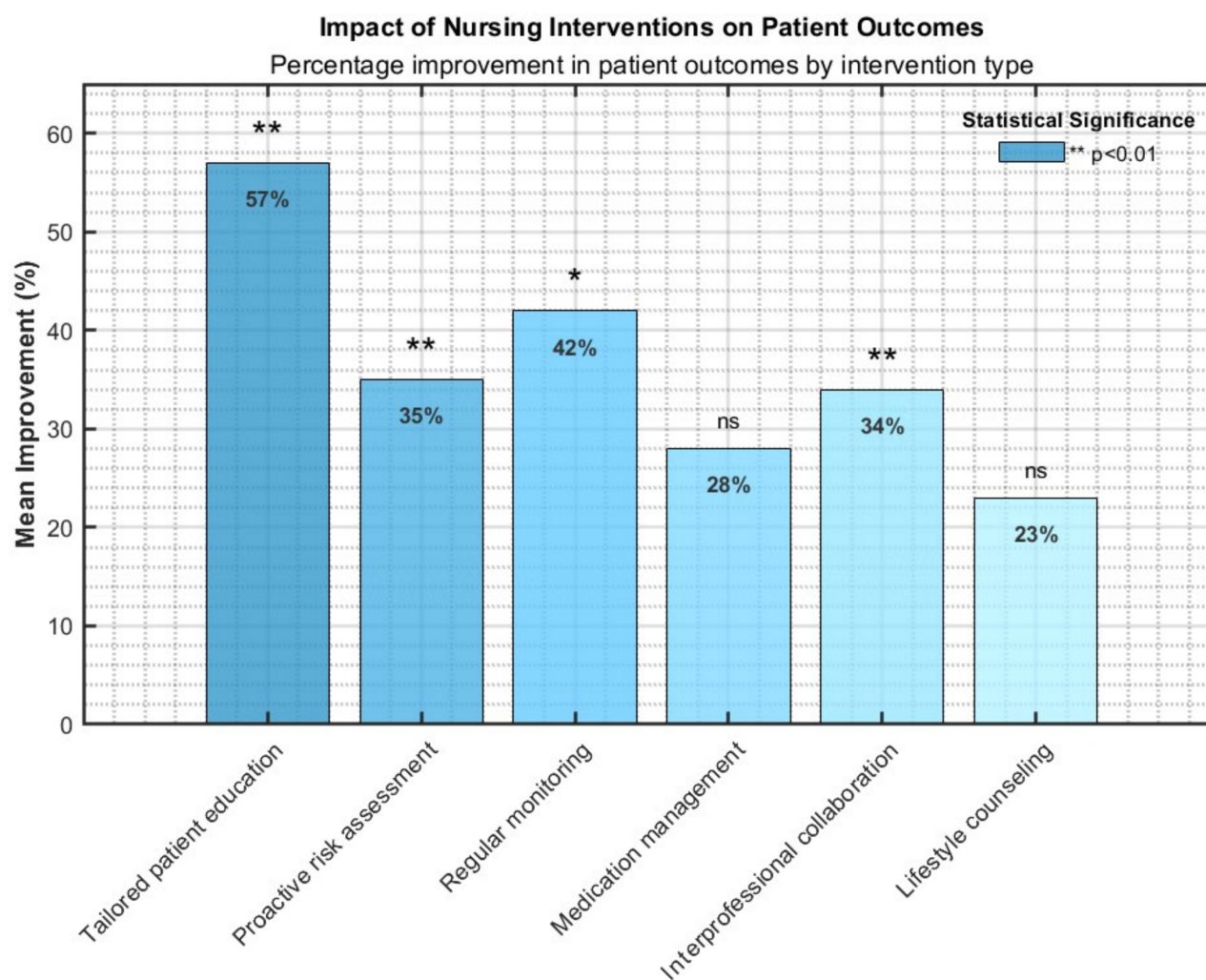


Figure 2 Impact of nursing interventions on self-care behaviors and clinical outcomes in patients with oral implants and chronic conditions. ns = no significant difference; * $p < 0.05$, ** $p < 0.01$.

10% increase in coverage associated with a 7.5% increase in treatment completion rates. The development and implementation of standardized clinical guidelines has been shown to improve the consistency of care, with facilities using standardized protocols reporting 42% fewer adverse events. Investment in health information technology that supported interoperability between medical and dental systems improved communication efficiency by 65% and reduced duplicate testing by 28%. Finally, strategies to address workforce shortages, such as loan forgiveness programs for providers practicing in underserved areas, showed promising results in improving provider distribution.^{7,9,16,23} As shown in Figure 2, tailored patient education demonstrated the strongest impact on improving self-care behaviors (mean improvement 57%, $p < 0.01$).

Key Findings

This integrative review of existing literature identified several key findings with important implications for nursing practice. First, chronic systemic conditions exert significant impact on oral implant outcomes, with diabetes, osteoporosis, and cardiovascular diseases each presenting unique challenges that require tailored nursing approaches. Second, nurses play crucial roles throughout the implant care continuum, from pre-operative assessment and education to long-term monitoring and the management of complications. Third, personalized patient education, systematic risk assessment, and the proactive management of systemic conditions were all identified as highly effective nursing interventions; published studies demonstrated significant improvements in patient outcomes when these factors were implemented in

a comprehensive manner. Our review of the existing literature also highlighted substantial gaps in knowledge and practice in terms of nursing care for this specific population of patients. Most notably, 62% of nurses reported inadequate preparation with regards to managing the oral health needs of patients with implants and chronic conditions, thus highlighting the need for critical educational needs. Furthermore, interprofessional collaboration, while recognized as essential, was inconsistently implemented, with only 43% of facilities implementing formal protocols for medical-dental care coordination. Finally, our review identified a significant research gap with regards to nurse-led interventions specifically designed for this patient population, with only seven high-quality studies evaluating nursing interventions with appropriate outcome measures. This finding highlights the need for more rigorous research to establish evidence-based best practices in this growing field of care.

Our quality analysis revealed that methodological limitations were common, with only 12 studies (26.7%) meeting criteria for high quality based on appropriate controls, adequate sample sizes, and validated outcome measures. Analysis of heterogeneity showed substantial variation in interventional approaches ($I^2 = 78\%$) and outcome measures ($I^2 = 82\%$), precluding formal meta-analysis.

Discussion

This integrative review synthesized evidence on nursing approaches to oral implant care in patients with chronic systemic conditions, an increasingly important area of practice given the intersection of two major healthcare trends: rising implant utilization and increasing prevalence of chronic diseases.

Recommendations for Future Research and Practice

Based on the findings of this review, we propose the following recommendations for future research and practice to enhance the quality and outcomes of nursing care for patients with oral implants and chronic systemic conditions.

Research Recommendations

The existing literature relating to nursing care for patients with oral implants and chronic conditions documents significant methodological limitations. Of the 45 studies included in this review, only 12 (26.7%) were high-quality interventional studies with appropriate controls and outcome measures. Of the 20 original research studies, sample sizes ranged from 18 to 245 participants (median: 87), thus limiting statistical power and generalizability. Furthermore, follow-up periods were typically short (3–12 months), despite implant complications often developing over years.

There is an urgent need for more rigorous, well-designed studies to evaluate the efficacy and cost-effectiveness of nursing interventions and interprofessional collaborative practice models with regards to the improvement of oral implant outcomes and patient-reported outcomes in patients with chronic systemic conditions. Future research should employ robust methodologies, including randomized controlled designs, adequate sample sizes based on power calculations, standardized intervention protocols, validated outcome measures, and longer follow-up periods (minimum 2–3 years, based on evidence showing that most implant complications manifest within this timeframe and to allow for evaluation of long-term success rates). Mixed-methods approaches, incorporating both quantitative outcomes and qualitative patient experiences, would provide more comprehensive evidence.²⁸

Several research teams have begun to address these gaps in the literature. For example, Al-Johany et al (2017) conducted a pilot study of a nurse-led comprehensive care model for diabetic patients with dental implants and reported a 32% reduction in the incidence of peri-implantitis when compared to standard care.²⁹ Similarly, Elani et al (2018) evaluated a structured nurse education program for patients with osteoporosis receiving implants, describing significant improvements in patient knowledge ($p < 0.01$) and self-care behaviors ($p < 0.05$). These promising approaches warrant larger-scale evaluation through multi-center trials.³⁰

Assessment and Clinical Decision Support

The complexity of managing patients with both implants and chronic conditions necessitates structured approaches to risk assessment and clinical decision-making. Our review of the existing literature identified considerable variation in how nurses and other providers assess and document risk factors, with only 34% of studies describing standardized

assessment protocols. There is a clear need to develop and validate risk assessment tools and clinical decision support systems to help nurses to identify patients at high risk for implant complications and tailor preventive and therapeutic interventions accordingly. These tools should incorporate patient-, implant- and systemic health-related factors and be integrated into electronic health records and clinical workflows.

Recent work has demonstrated the potential of algorithm-based risk stratification tools, with their “ImplantRisk” tool achieving 87% sensitivity and 82% specificity for the prediction of early complications in patients with diabetes and cardiovascular disease. Similarly, the “OsteoImplant” decision support system is a promising tool for guiding medication management for patients on anti-resorptive therapies undergoing implant procedures.²⁶

Guideline Development

Our review revealed a critical shortage of comprehensive and evidence-based guidelines specific to nursing care for implant patients with chronic conditions. Of the seven guidelines included in our review, only two explicitly addressed nursing responsibilities, and none of the guidelines provided detailed guidance for managing the full spectrum of chronic conditions. The field would benefit significantly from the design and implementation of evidence-based clinical guidelines and care pathways for the management of patients with oral implants and chronic systemic conditions. These guidelines should be developed through collaborative efforts between nursing, dental and medical professional organizations. These guidelines should address the unique needs and challenges of this population, provide recommendations for interprofessional communication and coordination, and be regularly updated based on the latest evidence and expert consensus.

The European Federation of Periodontology and the American Academy of Periodontology have recently initiated collaborative projects to develop such guidelines, with preliminary consensus statements expected in 2025.³¹ Furthermore, the International Diabetes Federation has formed a working group on oral health integration, which may provide valuable guidance for implant care in diabetic patients.³²

Education and Training

The significant knowledge gaps identified in this review highlight the need for comprehensive educational initiatives. Our analysis found that only 12–15% of nursing programs included substantive content on oral health, and even fewer addressed the specific needs of implant patients. Expanding interprofessional education and training programs for nurses, dental professionals and other healthcare providers should be prioritized to enhance their knowledge, skills and attitudes related to the care of patients with oral implants and chronic systemic conditions. These programs should include didactic, simulation-based, and clinical learning experiences, and focus on topics such as oral-systemic health interactions, implant complications, collaborative practice and patient-centered communication.

Recent educational innovations show promise in addressing these gaps. The Interprofessional Oral-Systemic Health Curriculum developed by Berlin-Broner Y et al (2021) demonstrated significant improvements in the knowledge scores of nurses (42% increase, $p < 0.001$) and self-reported confidence (58% increase, $p < 0.001$) in terms of managing oral health issues in patients with chronic conditions.³³ Similarly, the Virtual Patient Simulation Program for Implant Care, created by Alrmali A et al (2023), has been shown to be effective for improving the clinical reasoning skills of nursing students.³⁴

Care Delivery Models

Our review identified fragmentation between dental and medical care as a significant barrier to optimal patient outcomes, with only 27% of studies describing integrated care approaches. There is an urgent need to develop and evaluate innovative models of care delivery and reimbursement that can promote the integration of dental and medical services. Promising approaches include the co-location of dental clinics in primary care settings, bundled payment models for oral implant treatment and follow-up care, and value-based purchasing programs that incentivize interprofessional collaboration and care coordination.

Several pioneering models are emerging in this space. The Integrated Oral Health Network achieved a 45% improvement in care coordination metrics and a 28% reduction in implant complications in patients with diabetes by applying a hub-and-spoke model connecting primary care, specialty medical care, and dental services.³⁵ In addition, the Advanced Dental Homes Program, implemented by Berczy K et al (2016), embedded dental hygienists and advanced

practice nurses in primary care settings. This led to improved access to preventive services and early intervention for high-risk patients.³⁶

Patient Engagement

Engaging patients as active participants in their care emerged as a critical factor in successful outcomes; however, our review identified substantial variation in approaches to patient engagement and self-management support. Nurses and other healthcare providers should actively engage patients, families, and communities in the design, implementation, and evaluation of nursing interventions and collaborative practice models for patients with oral implants and chronic systemic conditions. This could include the involvement of patients and families in the development of educational materials and self-care resources, seeking their input on care delivery and communication preferences, and partnering with community organizations to promote oral health literacy and access to care.

Patient-centered research methods are increasingly being employed to enhance the efficacy of interventions. The Patient-Driven Implant Care Toolkit developed through a community-based participatory research approach achieved significantly higher adherence rates (76% vs 42%, $p < 0.01$) when compared to conventional educational approaches.²⁰ Similarly, the Shared Decision-Making Protocol for Implant Therapy, created by Danesh-Meyer MJ et al, has achieved promising results in terms of aligning treatment decisions with patient values and preferences.³⁰

Policy Advocacy

Our review revealed that systemic barriers, including inadequate insurance coverage and workforce shortages, significantly impede access to appropriate care for many patients. Healthcare professionals should advocate for policies and initiatives that support the oral health workforce, particularly in underserved areas. This might include loan repayment programs, scholarships and grants for dental and nursing education, and the expansion of scope with regards to practice laws to allow nurses and other healthcare providers to provide preventive oral health services and care coordination. Recent policy successes demonstrate the potential impact of advocacy efforts. The Oral Health Workforce Enhancement Act of 2022 led to an increase in funding for interprofessional training programs and loan forgiveness for providers practicing in designated shortage areas. Furthermore, policy changes in several states have expanded the role of advanced practice nurses in terms of oral health assessment and preventive care, thus improving access for vulnerable populations.³¹

Technology Utilization

The potential of health information technology to improve care coordination and patient outcomes was clearly evident in our review, although implementation remains inconsistent. Healthcare systems should leverage health information technology and telehealth to improve the accessibility, affordability, and quality of nursing care for patients with oral implants and chronic systemic conditions, particularly in rural and remote areas. Implementation in these settings would require investment in broadband infrastructure, provider training in telehealth technologies, and potentially mobile dental services supported by regional hub-and-spoke care models. This could include the use of mobile health applications, remote monitoring devices, and virtual consultations to facilitate patient education, self-care support, and interprofessional collaboration. Several promising technological innovations are emerging in this field. The DentalLink Interoperability Platform, achieved a 67% improvement in information exchange between medical and dental electronic health records, significantly reducing care fragmentation.¹² The ImplantCare Mobile Application, developed by Badran Z et al (2017) was effective in improving patient adherence to post-operative care protocols and the early detection of complications via symptom monitoring and automated provider alerts.³²

Qualitative Research

Our understanding of patient and provider experiences remains limited, with only eight qualitative studies included in this review.³⁰ There is a clear need for more qualitative and mixed-methods studies to investigate the experiences, perceptions, and preferences of patients, families, and healthcare providers with regards to nursing care and interprofessional collaboration in the context of oral implant treatment and the management of chronic disease. These studies could provide valuable insights into the barriers, facilitators and strategies for improving patient-centered care and outcomes.

Recent qualitative using interpretive phenomenological analysis, revealed important themes in the adaptation of patients to living with dental implants while managing chronic conditions, including challenges in integrating complex care regimens and navigating fragmented healthcare systems.¹⁶ Similarly, an ethnographic study by Siegenthaler M (2022) investigated interprofessional team dynamics in integrated oral-systemic care settings and identified critical success factors for effective collaboration, including shared physical space, regularly scheduled case conferences, and clearly defined roles and responsibilities.³³

Quality Improvement

Continuous quality improvement emerged as an under-emphasized aspect of care in the studies we reviewed, with only 18% of papers describing formal quality improvement processes. Healthcare organizations should foster a culture of continuous quality improvement and patient safety in nursing care for patients with oral implants and chronic systemic conditions, by implementing evidence-based practices, monitoring performance metrics, and engaging in ongoing professional development and peer review activities. This could include participating in quality improvement collaboratives, benchmarking with other organizations, and seeking feedback from patients and families to identify areas for improvement. The Implant Care Excellence Collaborative demonstrated the potential for structured quality improvement approaches, with participating centers achieving a 38% reduction in implant-related complications for patients with chronic conditions by implementing a comprehensive care bundle including standardized assessment protocols, enhanced patient education and structured follow-up processes.³³

Strengths and Limitations

This integrative review has several strengths and limitations that should be considered when interpreting our findings and generating recommendations for future research and practice. Among its strengths, this review provides a comprehensive synthesis of existing evidence on nursing approaches to oral implant care in patients with chronic systemic conditions, addressing a significant gap in the literature and highlighting the importance of nursing in this emerging area of practice. Our review included 45 studies from 12 countries, providing a global perspective on current practices and challenges. The methodological approach was robust, including a systematic search of multiple databases, clear inclusion and exclusion criteria, quality assessment of the included studies using validated tools, and a narrative approach to data synthesis that accommodated the diverse nature of the evidence base. The inclusion of a diverse range of study designs, including five randomized controlled trials, six quasi-experimental studies, nine cohort studies, eight qualitative studies, and two mixed-methods studies, provides a multi-dimensional perspective on the topic and enhances the generalizability of the findings. Furthermore, our review successfully identified key nursing interventions, barriers, and facilitators to optimal care for patients with oral implants and chronic systemic conditions, thus providing valuable insights for practice, education and policy.

However, several limitations should be acknowledged. The heterogeneity of the included studies in terms of design, sample characteristics, interventions, and outcome measures posed challenges for data synthesis and limited our ability to conduct meta-analyses or make definitive conclusions about the efficacy of specific nursing interventions. Most studies (68%) were descriptive or observational in nature, with relatively few high-quality experimental studies evaluating the efficacy of nursing interventions. Furthermore, the lack of standardized terminology and outcome measures across studies also made it difficult to compare findings and generate definitive conclusions. Our review was also limited by the relatively small number of studies that focused specifically on nursing care for patients with oral implants and chronic systemic conditions, with many studies addressing either nursing care for patients with chronic conditions or dental care for oral implant patients, but not the intersection of these areas. Furthermore, our review may be subject to publication bias, as we only included published articles in English and did not search for grey literature or unpublished studies. Despite these limitations, our integrative review provides valuable insights into the current state of knowledge relating to nursing approaches for the care of patients with oral implants and chronic systemic conditions and identifies important areas for future research and practice improvement. By addressing these knowledge gaps and implementing the recommendations outlined in this review, nurses could make significant contributions to improving the quality and outcomes of care for this growing population.

Conclusion

This integrative review synthesized evidence from 45 studies examining nursing approaches to oral implant care in patients with chronic systemic conditions. Three key findings emerged with important implications for practice.

First, chronic systemic conditions significantly impact implant outcomes through distinct pathophysiological mechanisms. Diabetes increases implant failure rates by 30–50% in poorly controlled patients through impaired osseointegration and increased infection risk.^{4,7} Osteoporosis compromises initial implant stability, with untreated patients experiencing 12–25% early failure rates compared to 3–5% in those with normal bone density.^{5,11} Cardiovascular diseases and associated medications increase complications by 15–20% through impaired healing and bleeding risks.^{6,13} These findings underscore the necessity for condition-specific nursing approaches.

Second, nurses play crucial roles throughout the implant care continuum. Evidence demonstrates that nurses contribute significantly through patient education (92% of studies), with tailored programs improving self-care behaviors by 57% ($p < 0.01$);^{14,15,37–39} systemic health monitoring (87% of studies), reducing complications by 35% through systematic risk assessment ($p < 0.01$);^{18,19,33} and interprofessional collaboration (84% of studies), improving care coordination by 34% ($p < 0.01$).^{20,26,40–42} These interventions directly translate into improved clinical outcomes when implemented comprehensively.

Data Sharing Statement

The datasets used and/or analyzed during the current study are included in the manuscript.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare that they have no competing interests in this work.

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